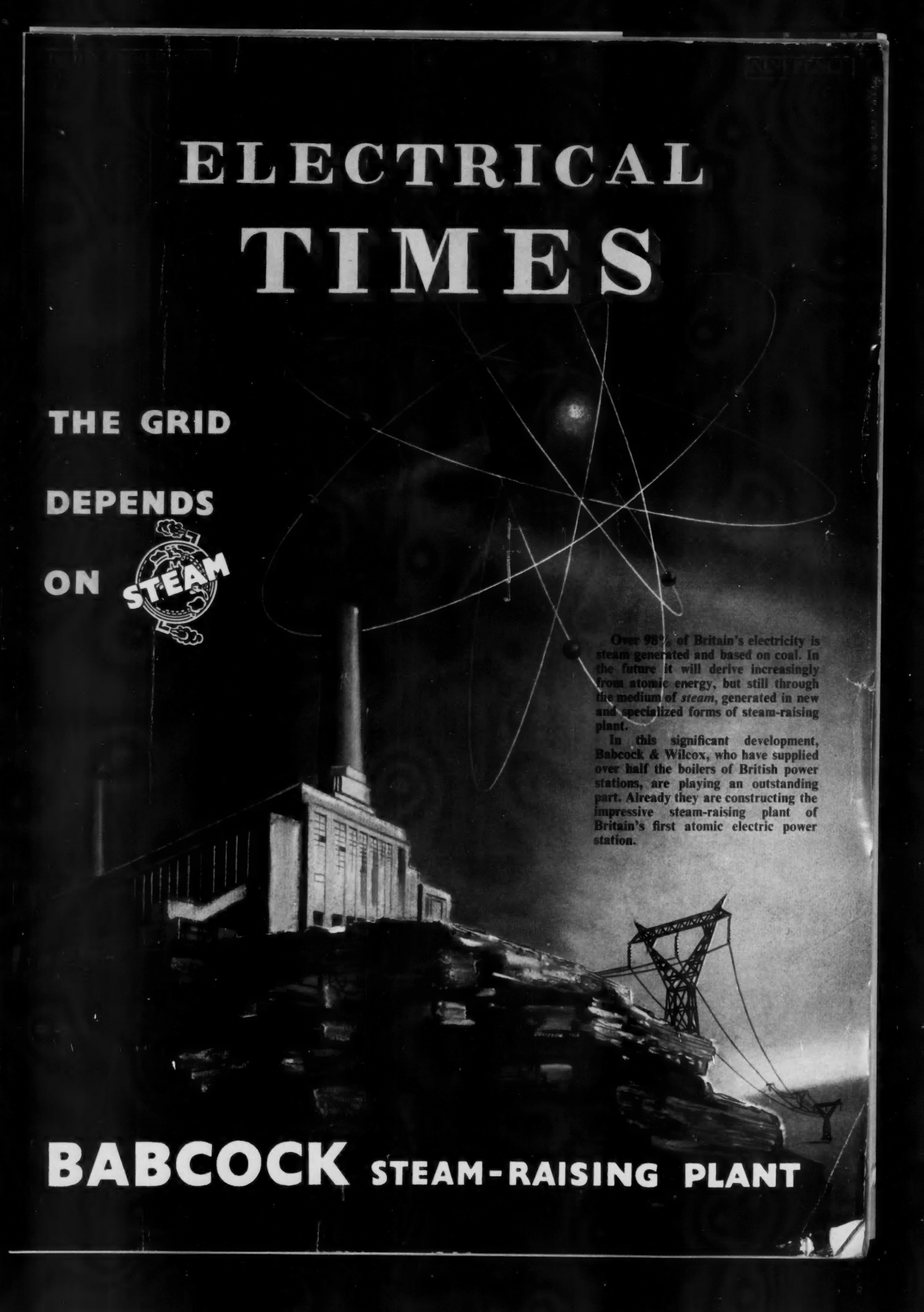
# ELECTRICAL TIMES

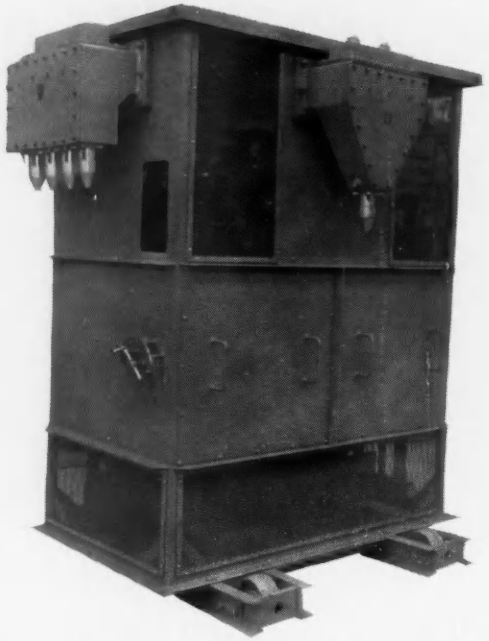
THE GRID DEPENDS ON STEAM



Over 98% of Britain's electricity is steam generated and based on coal. In the future it will derive increasingly from atomic energy, but still through the medium of *steam*, generated in new and specialized forms of steam-raising plant.

In this significant development, Babcock & Wilcox, who have supplied over half the boilers of British power stations, are playing an outstanding part. Already they are constructing the impressive steam-raising plant of Britain's first atomic electric power station.

**BABCOCK STEAM-RAISING PLANT**



A 500kVA, 11kV, T.W. Distribution Transformer, Dry Type Air Cooled with All Silicone Impregnated Insulation

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AND
BASEMENT
SUBSTATIONS

INSTAL

T.W. ALL SILICONE IMPREGNATED
DRY-TYPE AIR-COOLED TRANSFORMERS
USING ONLY CLASS H INSULATION

# NO FIRE RISK

*Special Features:—*

1) Smaller in size and weight than O.N. units.
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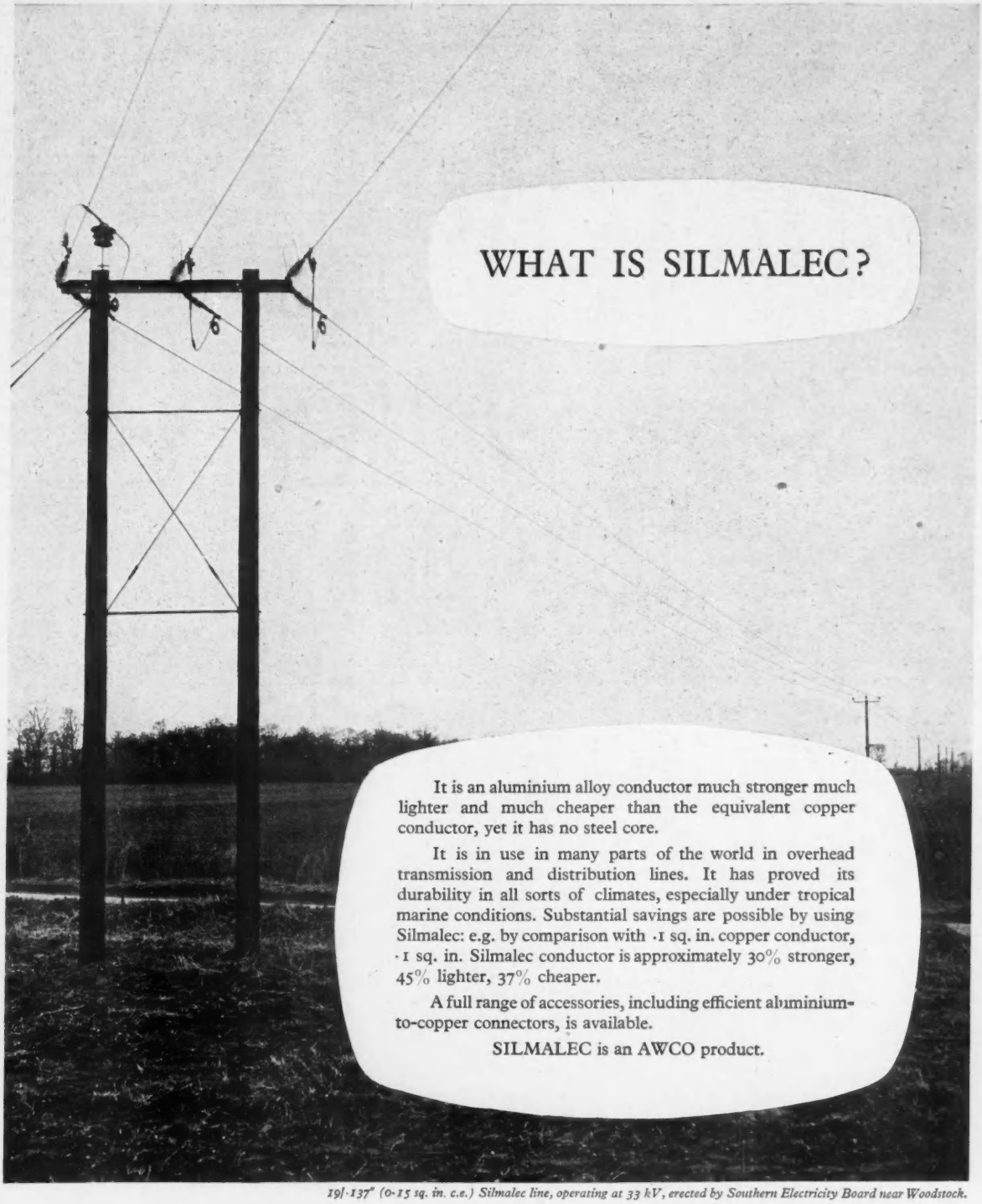
4) Less maintenance.
5) Dust, humidity, and ventilation no problem.

*Full details from:—*

TRANSFORMERS
(Watford) LIMITED
Sandown Road, Watford, Herts



# WHAT IS SILMALEC?

It is an aluminium alloy conductor much stronger much lighter and much cheaper than the equivalent copper conductor, yet it has no steel core.

It is in use in many parts of the world in overhead transmission and distribution lines. It has proved its durability in all sorts of climates, especially under tropical marine conditions. Substantial savings are possible by using Silmalec: e.g. by comparison with ·1 sq. in. copper conductor, ·1 sq. in. Silmalec conductor is approximately 30% stronger, 45% lighter, 37% cheaper.

A full range of accessories, including efficient aluminium-to-copper connectors, is available.

SILMALEC is an AWCO product.

*19/·137" (0·15 sq. in. c.e.) Silmalec line, operating at 33 kV, erected by Southern Electricity Board near Woodstock.*

AWCO

## ALUMINIUM WIRE & CABLE CO. LTD

*Britain's Largest Manufacturers of Aluminium Wire and Conductors*

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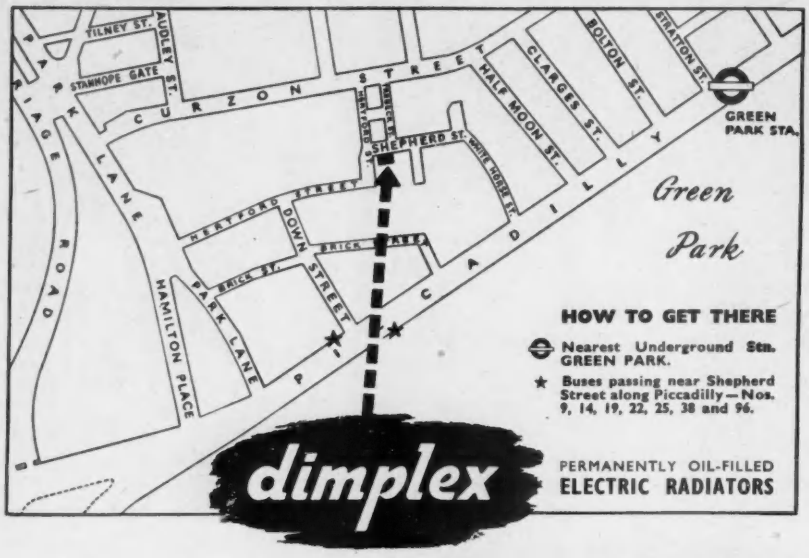
# DIMPLEX COMES TO TOWN!...NEW LONDON SHOWROOMS




Dimplex radiators have long been going to town — in all parts of the world. Now, Dimplex has literally *come* to town – in its own attractive, centrally situated showrooms in the heart of the West End. Here, our many friends and clients will be able to see the complete range of our products — in all colours, sizes, mountings and fittings — displayed to its best advantage. Which, in itself, is a great advantage — from all points of view. *We shall be glad to show you round.*

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CORRESPONDENCE AS USUAL TO DIMPLEX LTD., TOTTON, SOUTHAMPTON, HANTS. TELEPHONE: TOTTON 2481

## Switchboard Watchdogs

Install Brush H.R.C. cartridge fuse links to stand guard over your valuable electrical plant. These watchdogs—tireless thoroughbreds—never sleep. If a heavy, damaging fault current tries to slip past they snap it off well before the peak is reached. Voltage rise is negligible. A special shunt wire indicates the particular fuse which made the kill. The Brush H.R.C. fuse link range covers current ratings from 2 to 300 amperes and is to British Standard dimensions. Ask for the complete pedigree in Publication No. 81002.

H.R.C. Fuse Links by BRUSH

Brush Electrical Engineering Co., Ltd., Hopkinson Works, Cardiff, Great Britain

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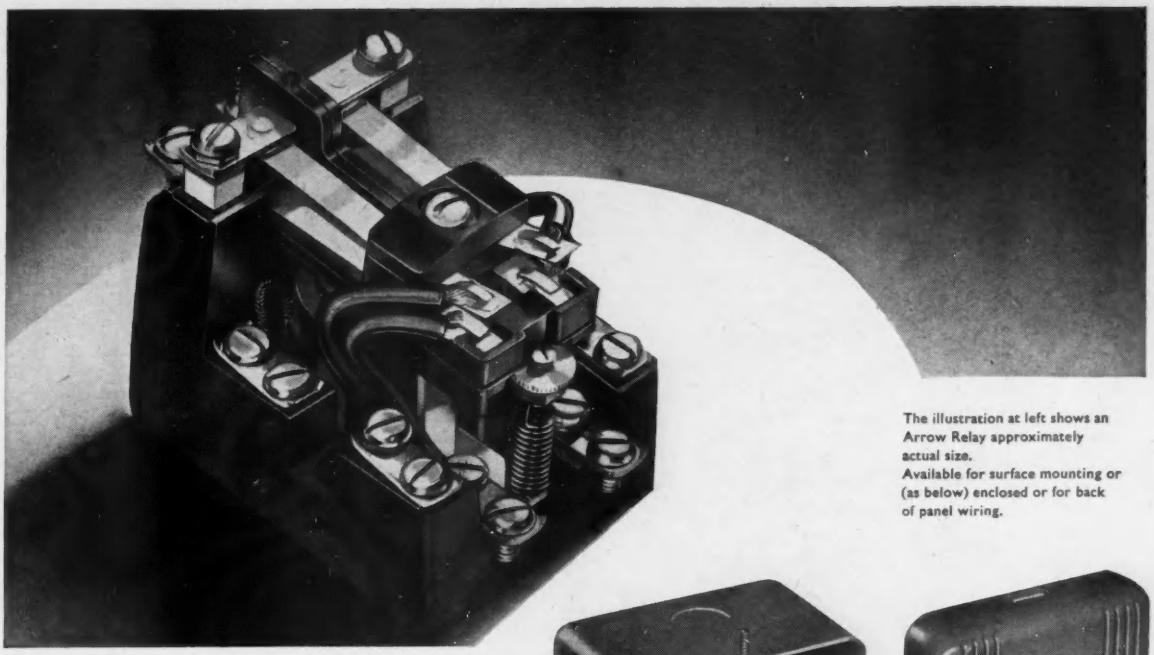
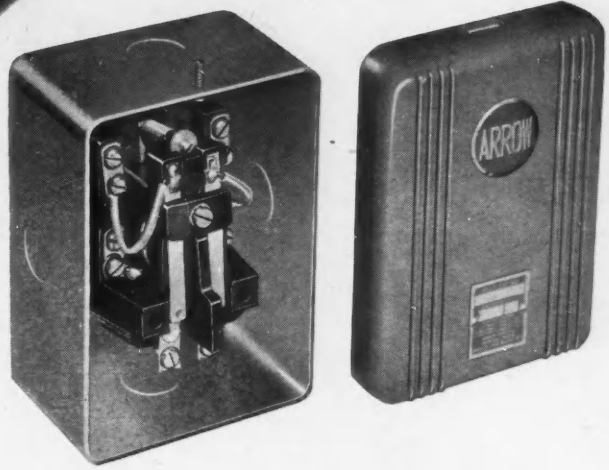
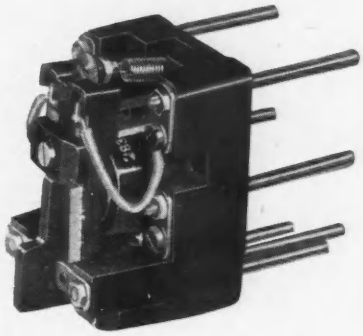


The illustration at left shows an Arrow Relay approximately actual size.
Available for surface mounting or (as below) enclosed or for back of panel wiring.




# *Relays for long and silent service . . .*

Made by skilled craftsmen from first-quality materials, Arrow Relays, like all Arrow products, are individually produced; they are designed and built to ensure exceptionally long and silent service. Essentially compact, no less than thirty different circuit arrangements are available on the standard base. Silver-to-silver butt type contacts give continuous rating up to 10 amps per pole at 230 volts AC. Operating coils, of low wattage consumption and continuously rated, are available for 6 to 550 volts AC and 6 to 230 volts DC.



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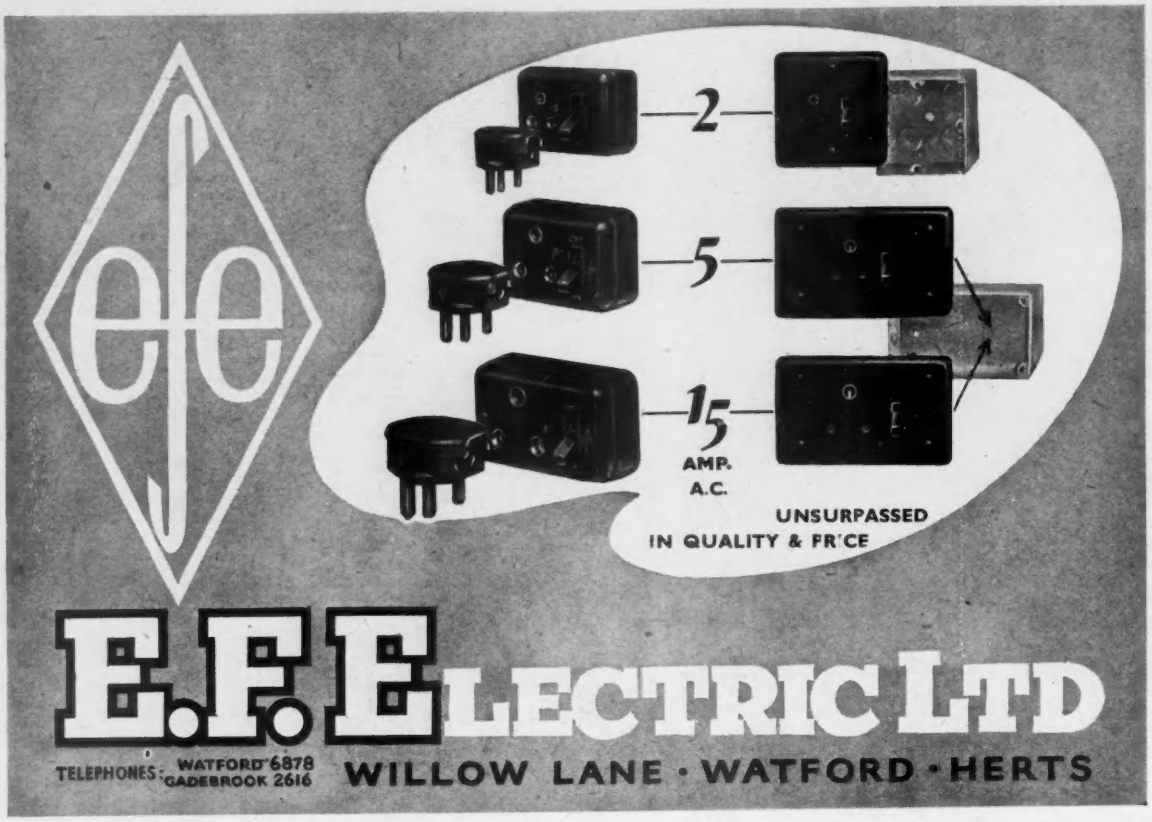


... became increasingly obvious it was a job for repetition specialists. So we called in Griffiths, Gilbart, Lloyd and I must say it was the most sensible thing we have done for a long time. They soon showed us the difference between our.....

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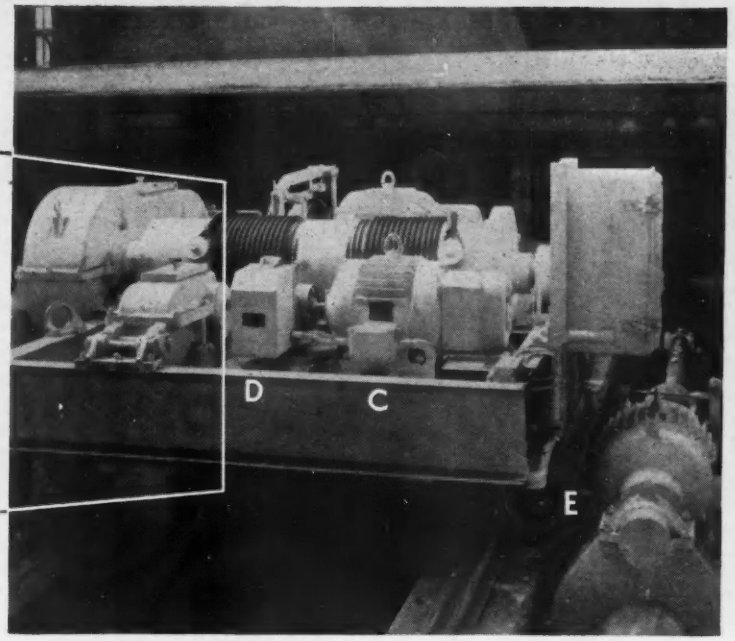
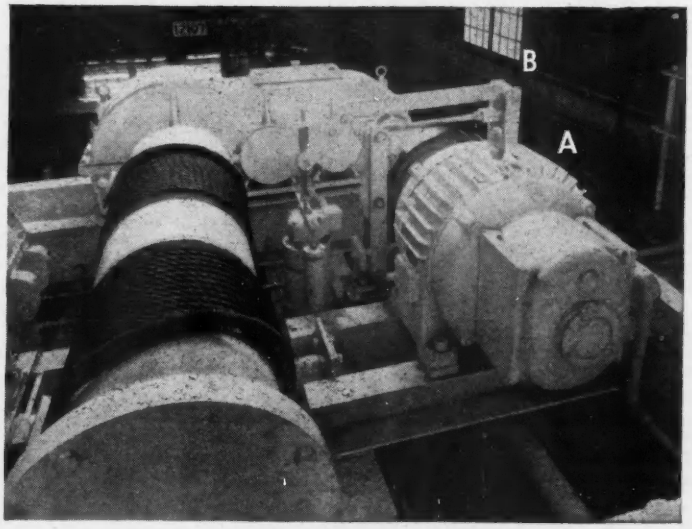
# ON TOP OF THE JOB




Metrovick equipment is well on top in this 10-ton Wharton overhead shop crane. The hoist is an 18-h.p. 720 r.p.m. M-V motor fitted with a thrustor-operated brake giving precise control with stable creeping speed on load. The need for inching is thus eliminated. Drives for the long travel and cross-traverse are M-V 10-h.p. 715 r.p.m. and 3-h.p. 700 r.p.m. type MZ slipring motors respectively. A 6-inch Perigrip brake operates on the cross traverse. Write for details of the range of M-V a.c. and d.c. motors, control gear and Perigrip electromagnetic brakes for crane drives.




*In the illustration (left) A is the 18-h.p. 720 r.p.m. hoist motor fitted with Stacreep thrustor control B. The long-travel drive, motor E, is shown at the top of page. The 3 h.p. cross traverse motor is seen at C and the 6-inch Perigrip brake at D.*

METROPOLITAN-VICKERS
ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

*Member of the A.E.I. group of companies*

M/C 301

* *

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* * *

**Now that 1954**

**is drawing to a close,**

**we should like to thank**

**you for your whole-hearted**

**support during the past year.**

*** * Everyone here sends you * ***

**warmest greetings for Christmas and**

**the New Year, which we hope will prove to**

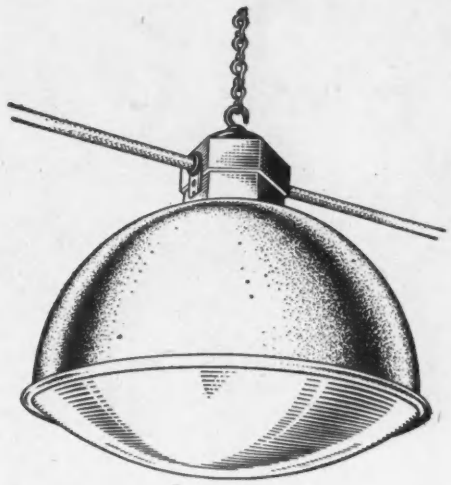
*** be as prosperous as this one. ***

**BELLING & COMPANY LIMITED**

*Bridge Works, Enfield, Middlesex.*

CRC 424

*an additional economy when using GRID SUSPENSION the economical wiring system*



## the ENsphere '*Perspex*' * Lighting Fitting

Lighter in weight, and having a light output ratio higher than the corresponding vitreous enamelled steel reflector, the new ENsphere Lighting Fitting is especially designed for use with GRID SUSPENSION — the economical wiring system.

The ENsphere cable connection is a part of the lighting fitting, no down connections or boxes are necessary, and (as with all Grid Suspension installations) no wires are cut in the making off. All work can be done at ground level, the completed span of steel-cored cable being lifted into position and tensioned between existing walls or steelwork. Long distances can be spanned in this way without conduit.

ENsphere reflectors are made in opal "Perspex"* and may be used open or with an inverted cover. The range of ENsphere fittings now includes 100/150, 200, 300 and 500 watt sizes for tungsten lamps. Please write for full technical data.

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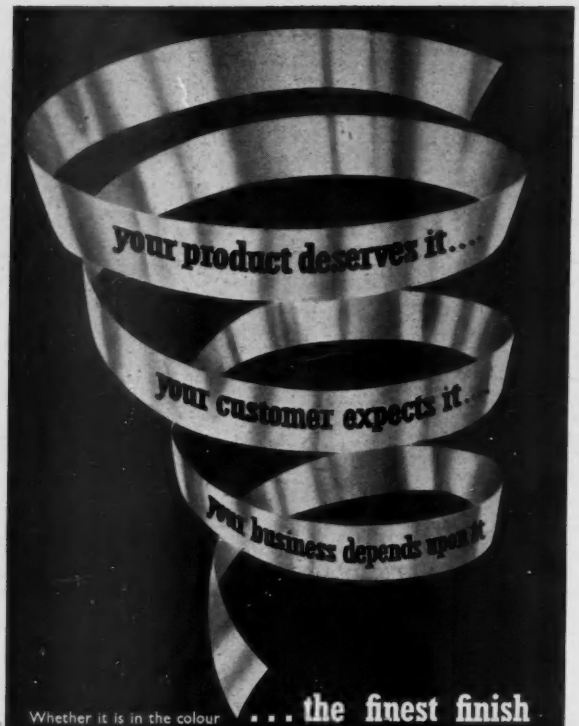


## . . . the finest finish

Whether it is in the colour anodising of aluminium or aluminium alloys in complete textile colour ranges, or indeed, in any aluminium finishing process, early consultation with us will ensure that your product is given not only good appearance but hard, long-life protection —in fact the finish for which we are famous. Fast colours, brighter reflection, and the greatest resistance to corrosion and abrasion are available through our patented processes.

We were the first to use eight of the major metal finishing processes in this country and we have remained first at every progressive step.

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**ALUMILITE** An electrolytic process for producing extremely hard and protective coatings on aluminium and aluminium alloys for all service conditions. The minute porosity of the film enables it to be impregnated with an attractive range of colours, which are subsequently made permanent by a special sealing process.

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**ALPOL** A chemical immersion process for producing bright surfaces on commercial aluminium. If required, the product can be specially treated by the Alumilite process to prevent tarnishing or to obtain a bright colour finish.

**ENAMEL PLATE** Our latest electrolytic process for producing on aluminium a hard, opaque porcelain finish in a range of seven pastel shades. The surface is resistant to all beverages — including spirits — cosmetics, perfumes and toilet preparations and will in no circumstances chip, flake or burn.

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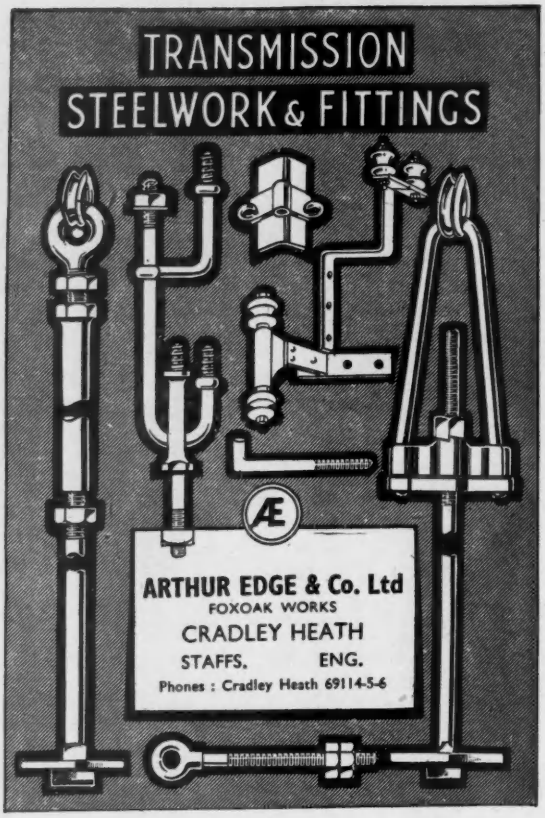

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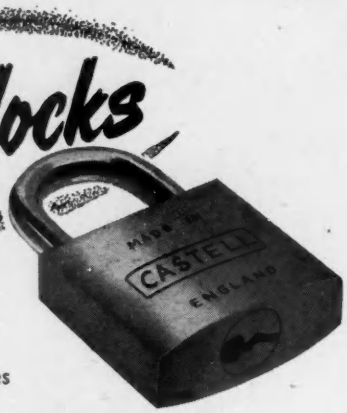


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*Castings from a few ounces to 10 tons in phosphor-bronze, gun-metal, aluminium-bronze, manganese-bronze and light alloys. Precision-machined bushes and bearings. Specialists in high-tensile aluminium-bronze castings, centrifugal-cast wheel blanks, and chill-cast rods and tubes.*

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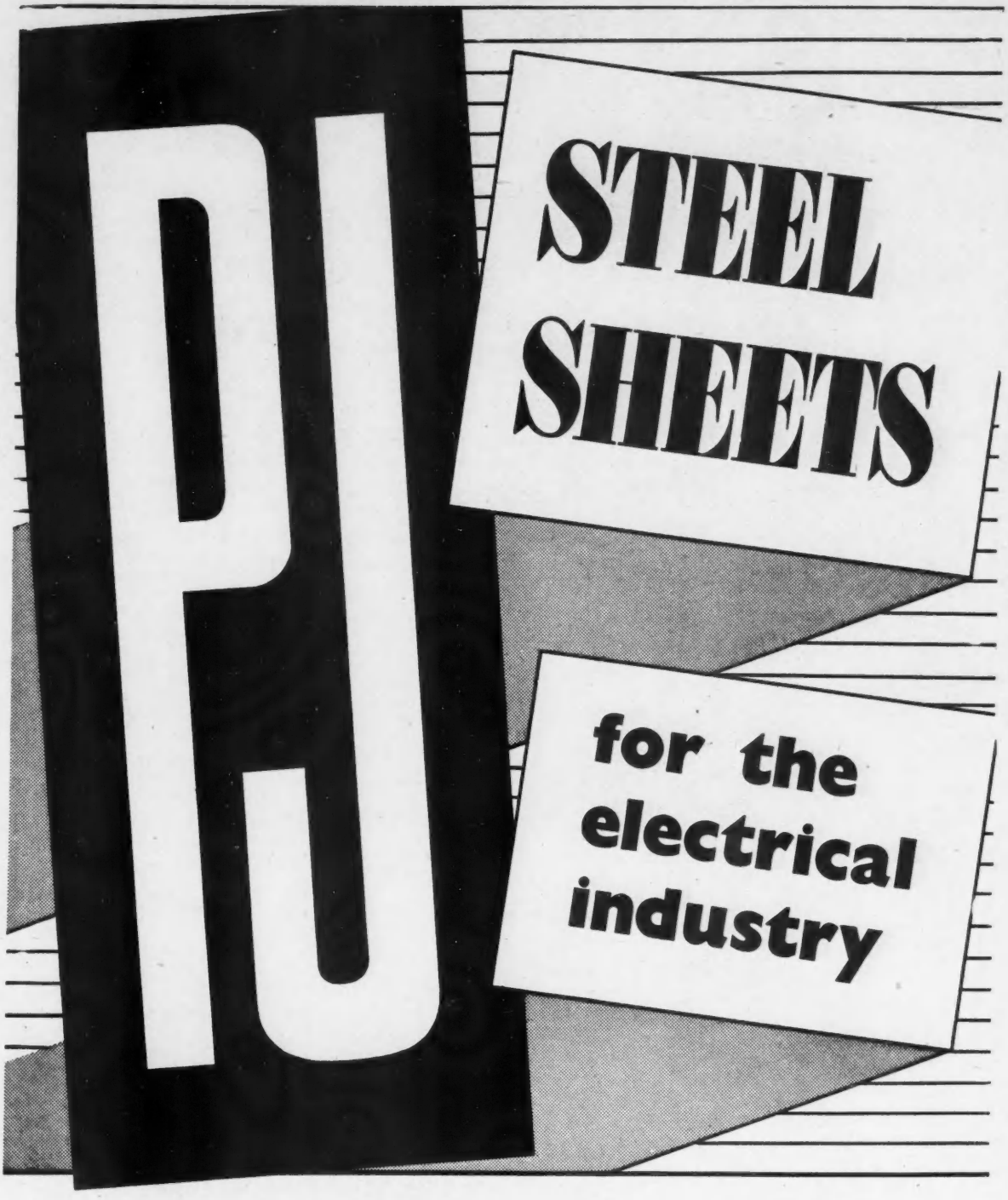


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## ENAMELLED WINDING WIRE

SEVERAL YEARS' RESEARCH lies behind the introduction of the new silicone wire enamel MS 1360. It has the toughness, flexibility, solvent resistance and adhesion expected of modern wire enamels and in addition has *outstanding heat stability*.

Accelerated life testing of electric motors wound with MS 1360-enamelled wire and insulated with silicone-bonded (Class H) components indicates that such motors, when operated at an average copper temperature between 160°C and 180°C, have a life comparable to Class A insulated motors operated within their normal temperature limits.

MS 1360-enamelled wire is available in fine and medium coverings, as defined in B.S. 1844. *Ask for Silicone Notes* C18—*Silicone enamelled wire* (*shortly available*).

Information about suppliers of wire and silicone insulating components is contained in Silicone Notes C 19, obtainable on request from:

# MIDLAND SILICONES LTD.

*An associate company of ALBRIGHT & WILSON Ltd.*

**first** *in British Silicones*

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# *Progress Report*

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Increasing demand for SenTerCel selenium rectifiers, germanium devices and SenTerCet equipment is evidence that these products are meeting the exacting needs of industry.

"Standard's" policy of continually improving quality and increasing production is expressed in a bold plan to move its Rectifier Division to a new factory in Harlow, Essex.

This factory, the largest in Europe built solely for the production of metal rectifiers, has been designed specifically to provide the particular facilities essential to the manufacture of these products.

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*Registered Office: Connaught House, Aldwych, London, W.C.2*

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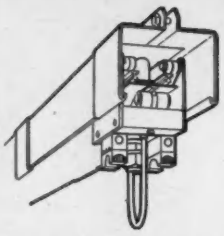
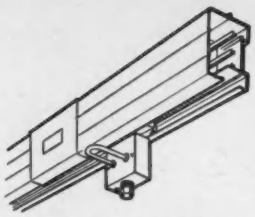
Telephone: Harlow 26811 Telegrams: Sentercel, Harlow

# power all along the line

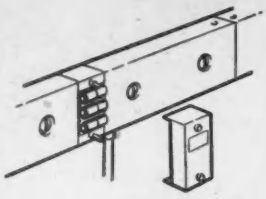
At all stations along the production line electrical power is readily available from E.M.S. distribution equipment. With these specialist products you have the safest and most economical form of power distribution for conveyor systems, portable tool installations, moveable pendant lights, etc. Write for literature giving full details of this equipment.



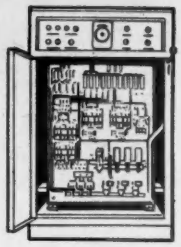
**TROLLEY DUCT FEED RAIL** This rigid foolproof system of power distribution avoids the dangers of long trailing leads on portable tool installations, conveyor systems, moveable pendant lights, etc. It consists of one or more trolley collectors running on continuous conductor rails, and is suitable for supplies up to 250 V a.c. single-phase with a maximum loading of 5 amps per appliance.



**"UNIDUCT" FEED RAIL** Where higher voltages are involved, the "Uniduct" Feed Rail provides power where you want it, without the dangers of bare conductors and trailing leads. Designed for 400 volt, 3-phase supply, with a maximum load of 100 amps per phase, the "Uniduct" is particularly suitable for high frequency tool installations on conveyor systems, small, mobile cranes and hoists.



**"MINIBUS" DISTRIBUTION SYSTEM** A power take-off every two feet—that's the outstanding advantage of the "Minibus" Distribution System. Designed particularly for smaller industrial installations where total loading does not exceed 100 amps per bar, and the load of each machine does not exceed 30 amps. Available for 2-phase, 3- and 4-wire supplies.



**CONTROL PANEL** This automatic panel built for I.C.I. is a typical example of our work in this field. We undertake the whole job—from the wiring diagrams to the finished panels which can be supplied in external cases or in skeleton form for building in.

## E.M.S. ELECTRICAL PRODUCTS LTD

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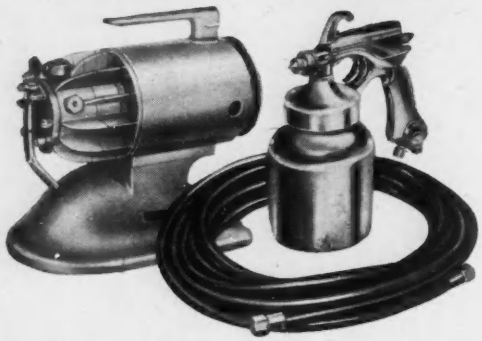
# MARTINDALE
## ELECTRIC SPRAYER



A small, compact and ultra-lightweight unit that will spray almost any medium at speeds up to one square yard per minute. The equipment comprises: A powerful, sliding vane, automatically lubricated **Compressor.** A lightweight "bleed" type **Gun** with a quart size **Paint Jar.** All necessary **Hoses** and **Connections,** bottle of special oil, funnel, set of tools and alternative nozzle.

Weight complete about 22 lb. Standard voltages 110, 200/220, 230/250. Special voltages to order.

*A pressure feed Container with equipment is available as an extra.*

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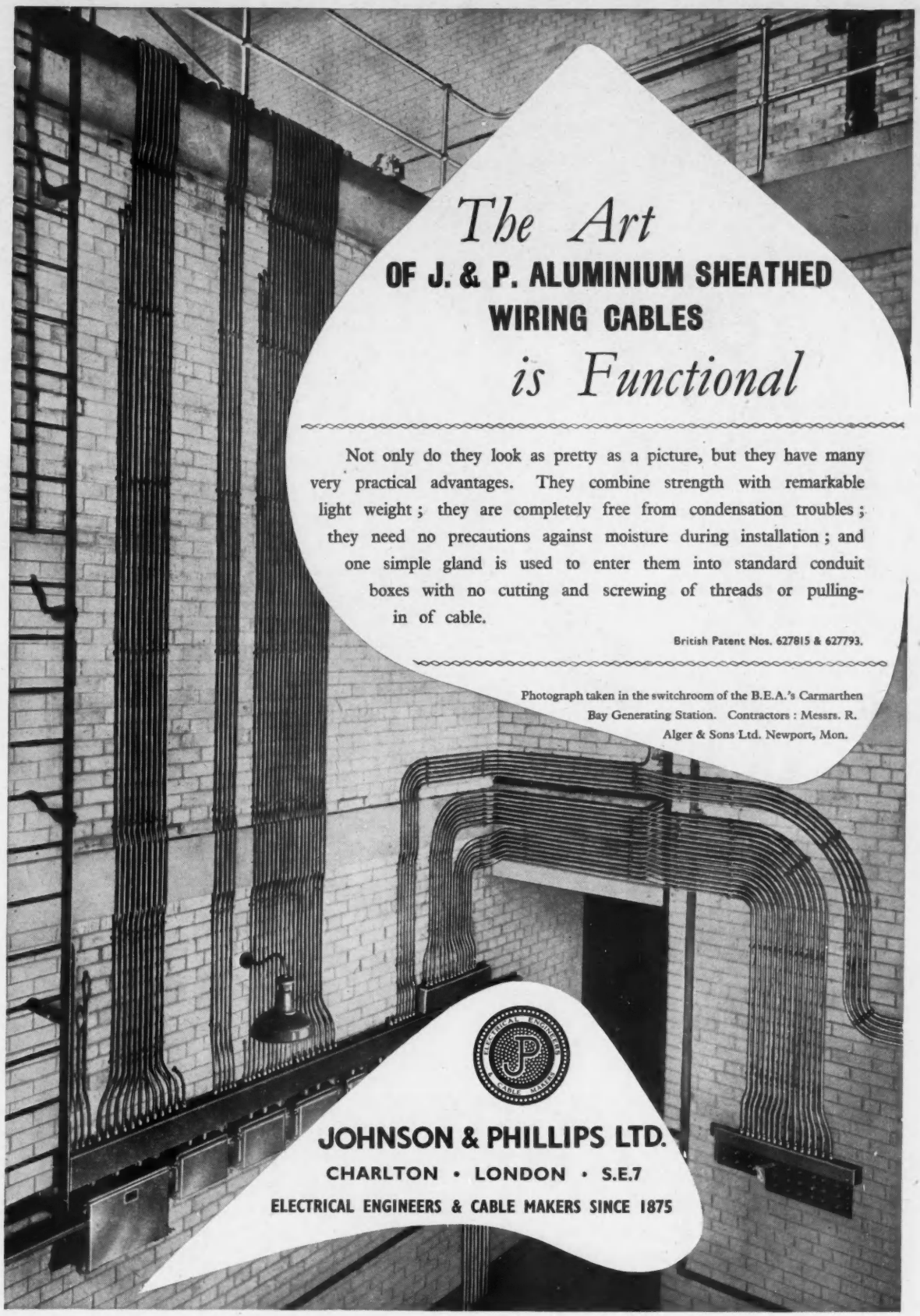


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*is Functional*

Not only do they look as pretty as a picture, but they have many very practical advantages. They combine strength with remarkable light weight; they are completely free from condensation troubles; they need no precautions against moisture during installation; and one simple gland is used to enter them into standard conduit boxes with no cutting and screwing of threads or pulling-in of cable.

British Patent Nos. 627815 & 627793.

Photograph taken in the switchroom of the B.E.A.'s Carmarthen Bay Generating Station. Contractors: Messrs. R. Alger & Sons Ltd. Newport, Mon.

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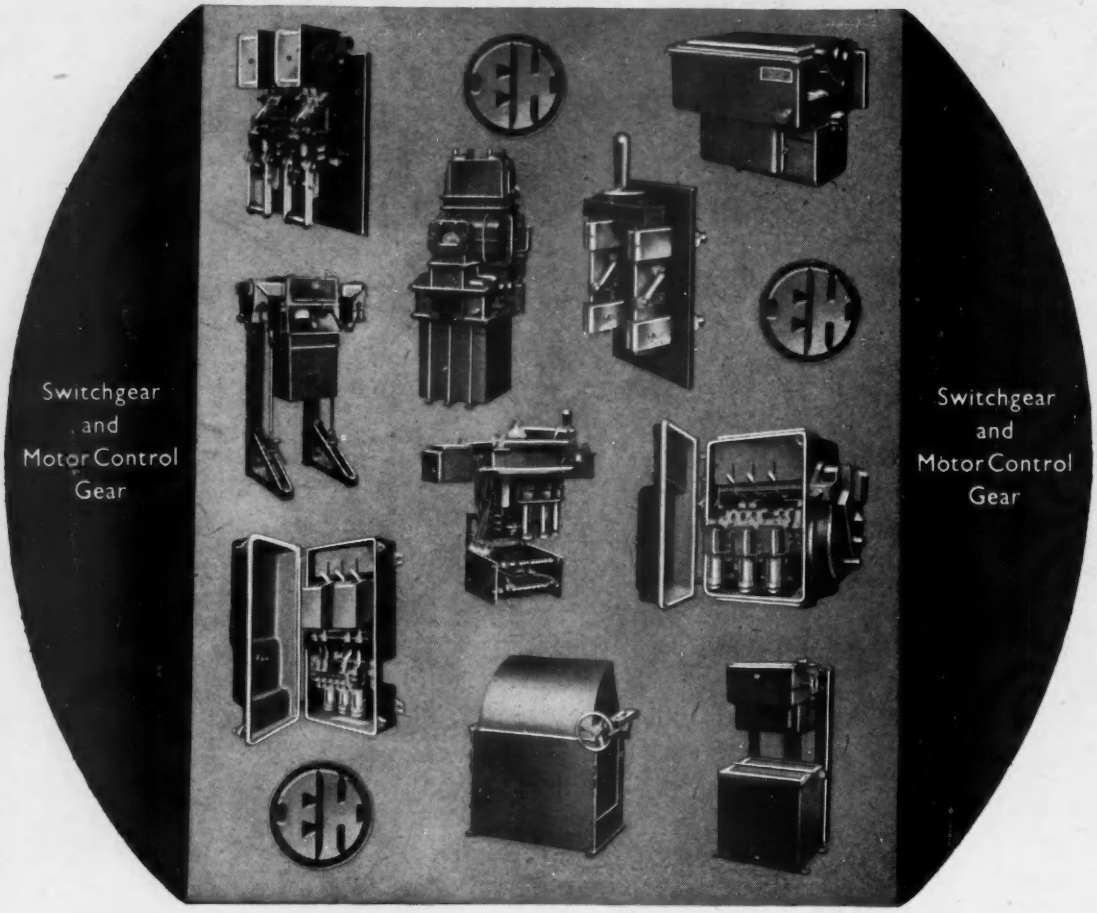


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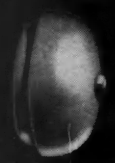

**Fig. 396 "UNDERDOME" BELL**
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**Fig. 398 "ALL-IN-ONE" BELL**
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**Fig. 382 "TWO-IN-ONE" BELL**
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**Fig. 391 BAKELITE CASED BELL**
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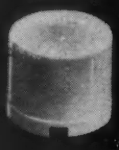

Fig. 384
**MINIATURE DUO-TONE BUZZER**
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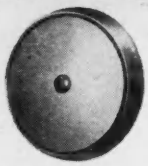

**Fig. 1079**
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**Fig. 1132 TRANSFORMER**
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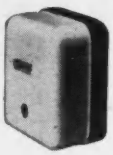

**Fig. 1139 TRANSFORMER***
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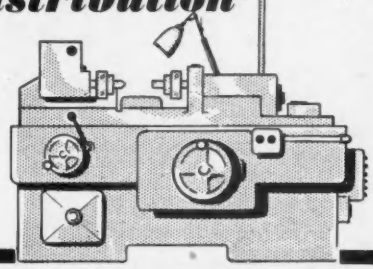

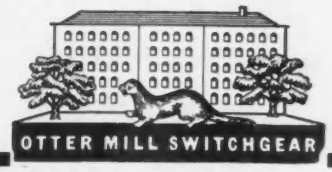


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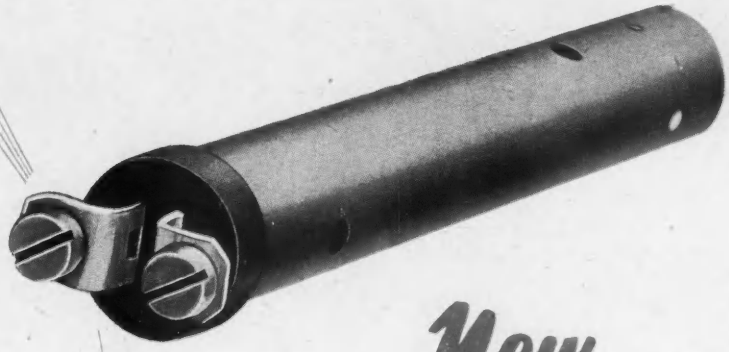

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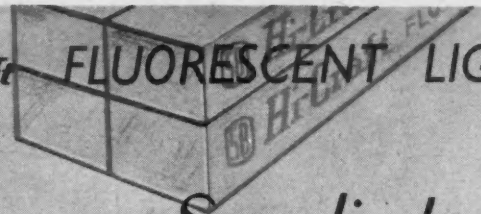

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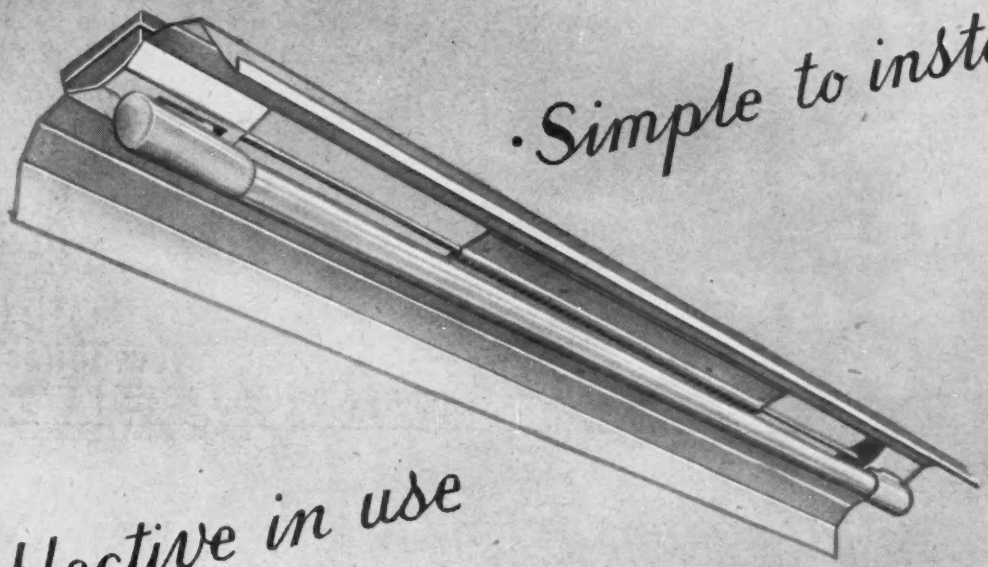

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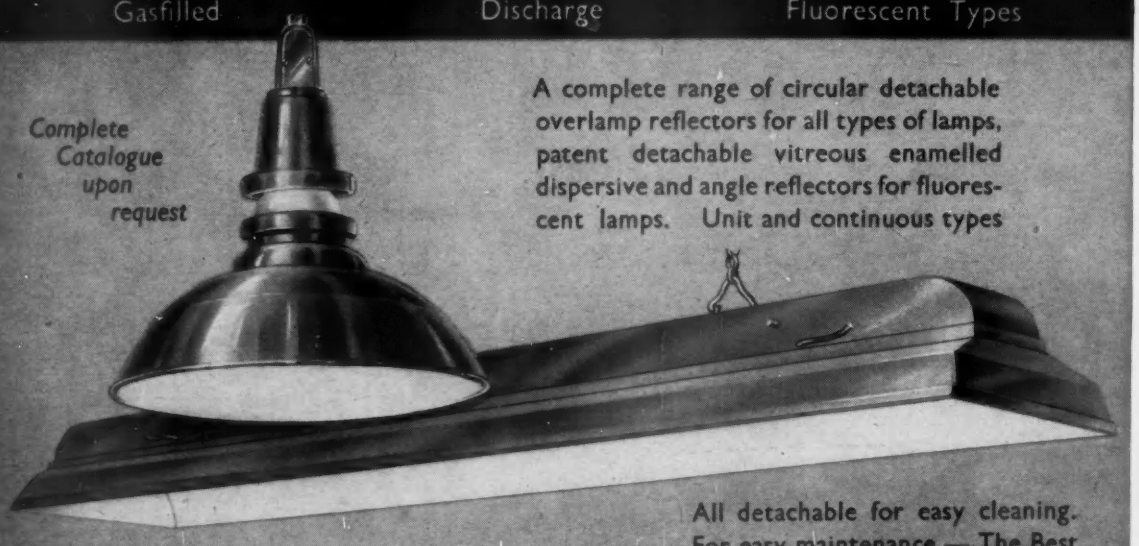

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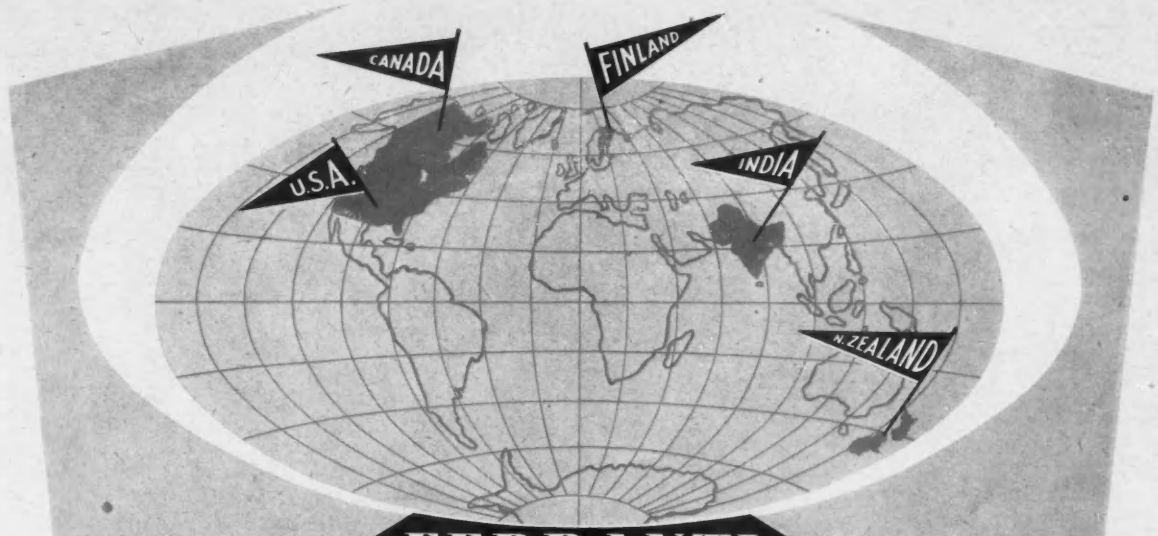


# FERRANTI
## TRANSFORMERS

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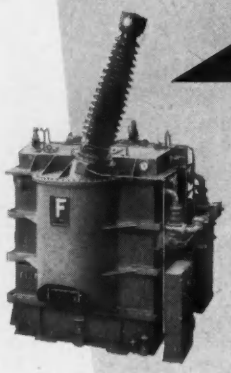
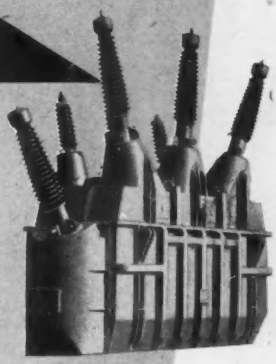


**U.S.A.** Nine 33,333 kVA, 230,000 volt single-phase Ferranti transformers are being supplied to the U.S. Army Corps of Engineers for the Garrison Dam Project, North Dakota, U.S.A. Three, forming the first 100,000 kVA bank, have been shipped.

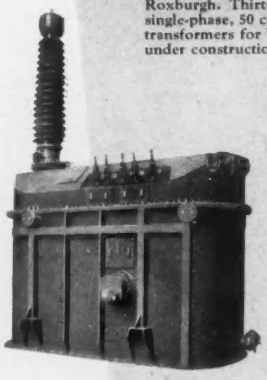
**FINLAND** Six 230,000 volt, three-phase Ferranti transformers have been ordered by the Imatra Power Company, Finland, for the Hikia Transforming Station and the Pyhäkoski Generating Station. Five are now in commission.

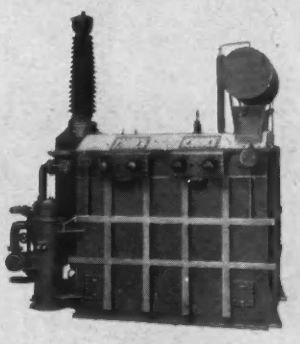


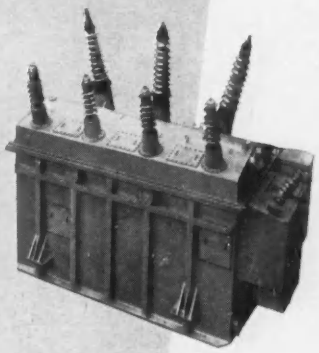
**NEW ZEALAND** Twenty-six Ferranti large power transformers have been ordered by the State Hydro-Electric Department of New Zealand. Thirteen 14,800 kVA, single-phase, 50 cycles, 11/220 kV transformers have already been supplied to Roxburgh. Thirteen 9,259 kVA, single-phase, 50 cycles, 11/220 kV transformers for Whakamaru are under construction.

**CANADA** Four 71,000 kVA, 301,400 volt single-phase Ferranti generator transformers and three 37,000 kVA, 275,000 volt step-down Ferranti transformers have been supplied to the Aluminum Company of Canada Limited for the Alcan Project at Kemano and Kitimat, British Columbia.

**INDIA** Three Ferranti 20,000 kVA, OFB, 3-phase, 50 cycles, 132/33.66 kV Transformers with on-load tap changing gear and two Ferranti 10,000 kVA, ON/OB, 3-phase, 50 cycles, 132/33 kV transformers with on-load tap changing gear have been supplied for the Damodar Valley Power Scheme in India.







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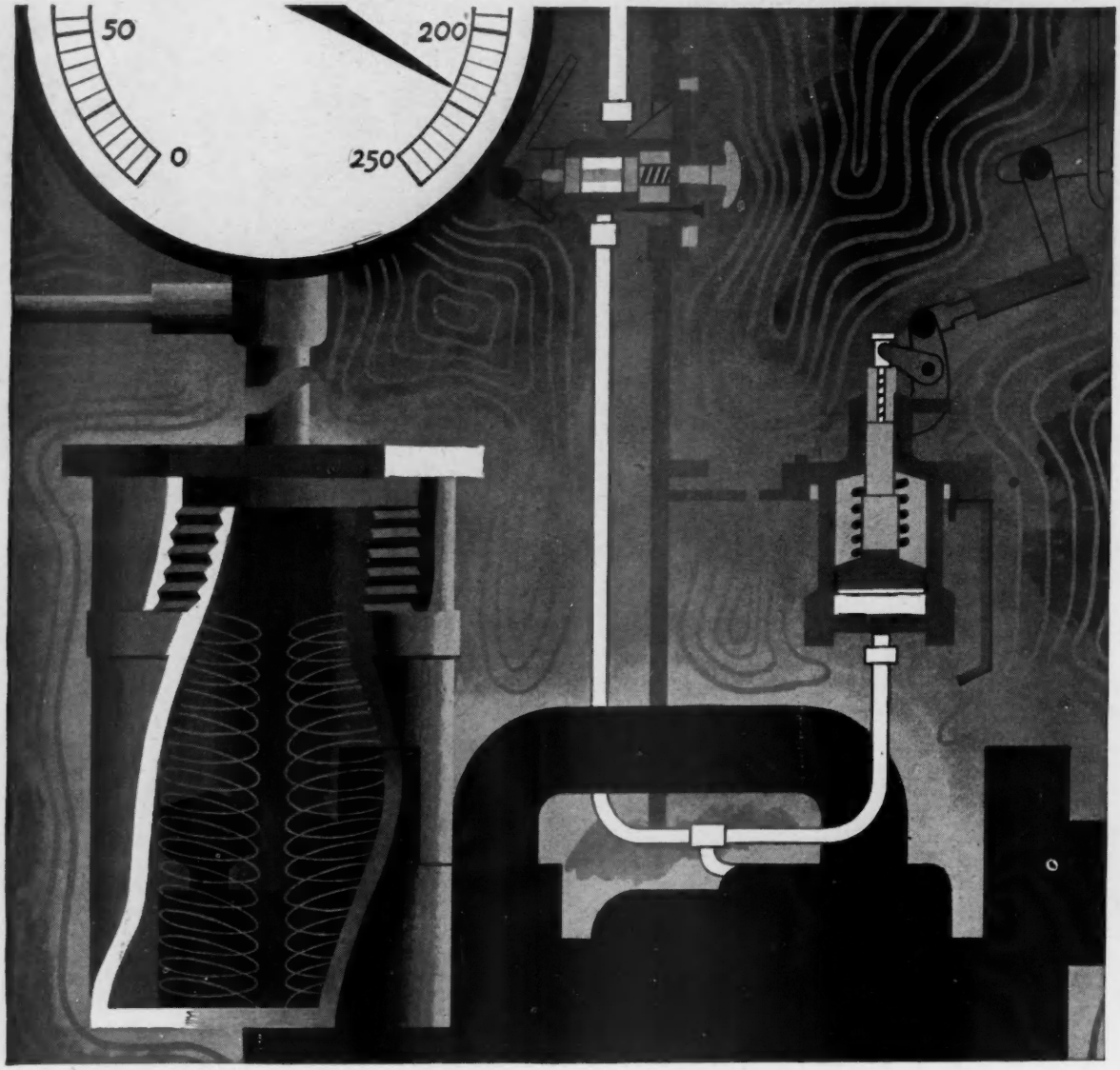


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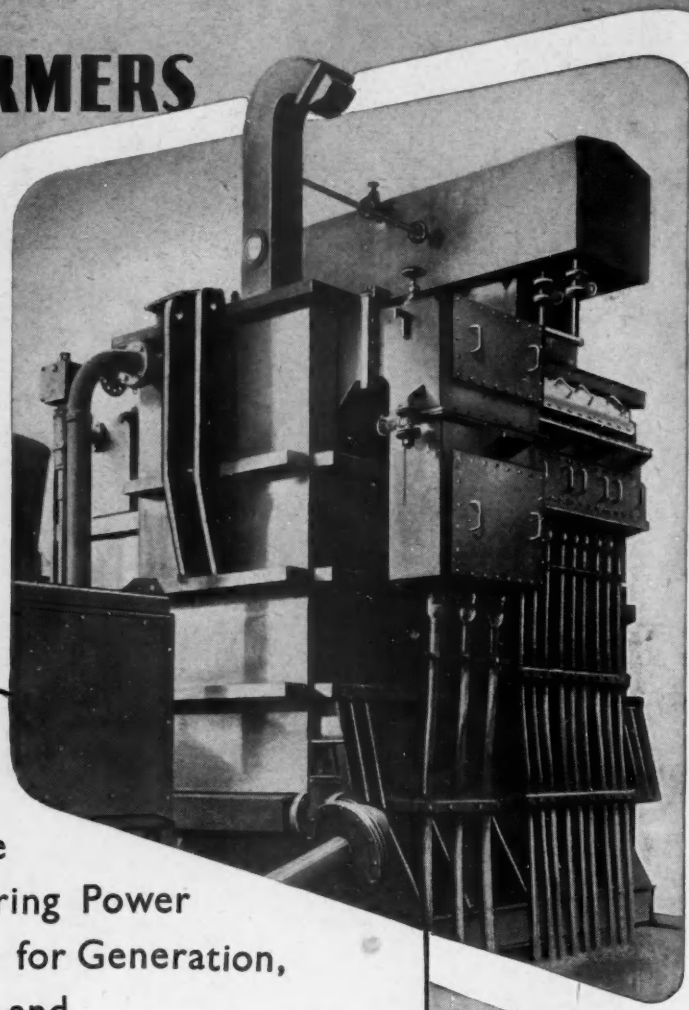

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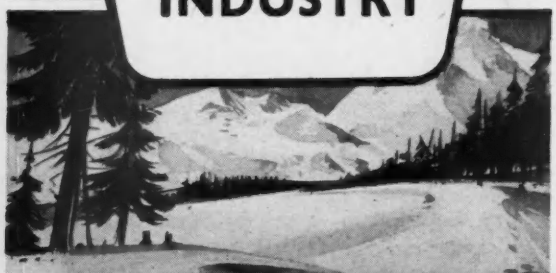

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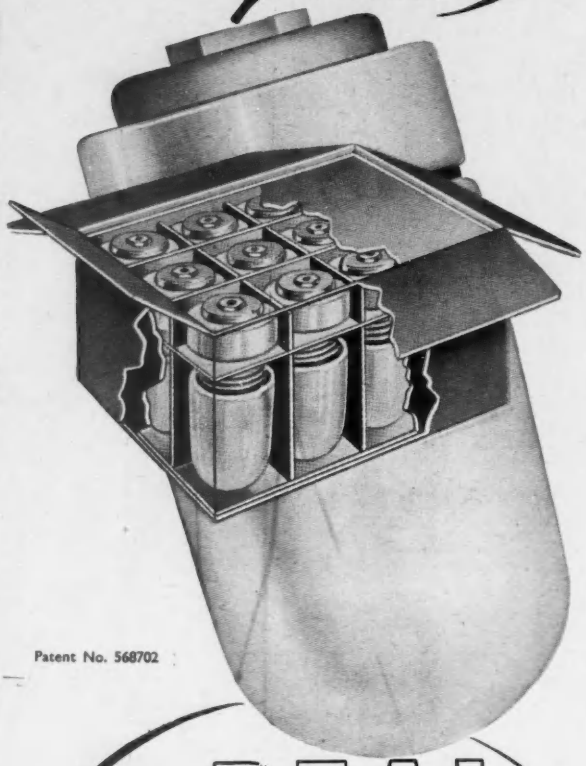

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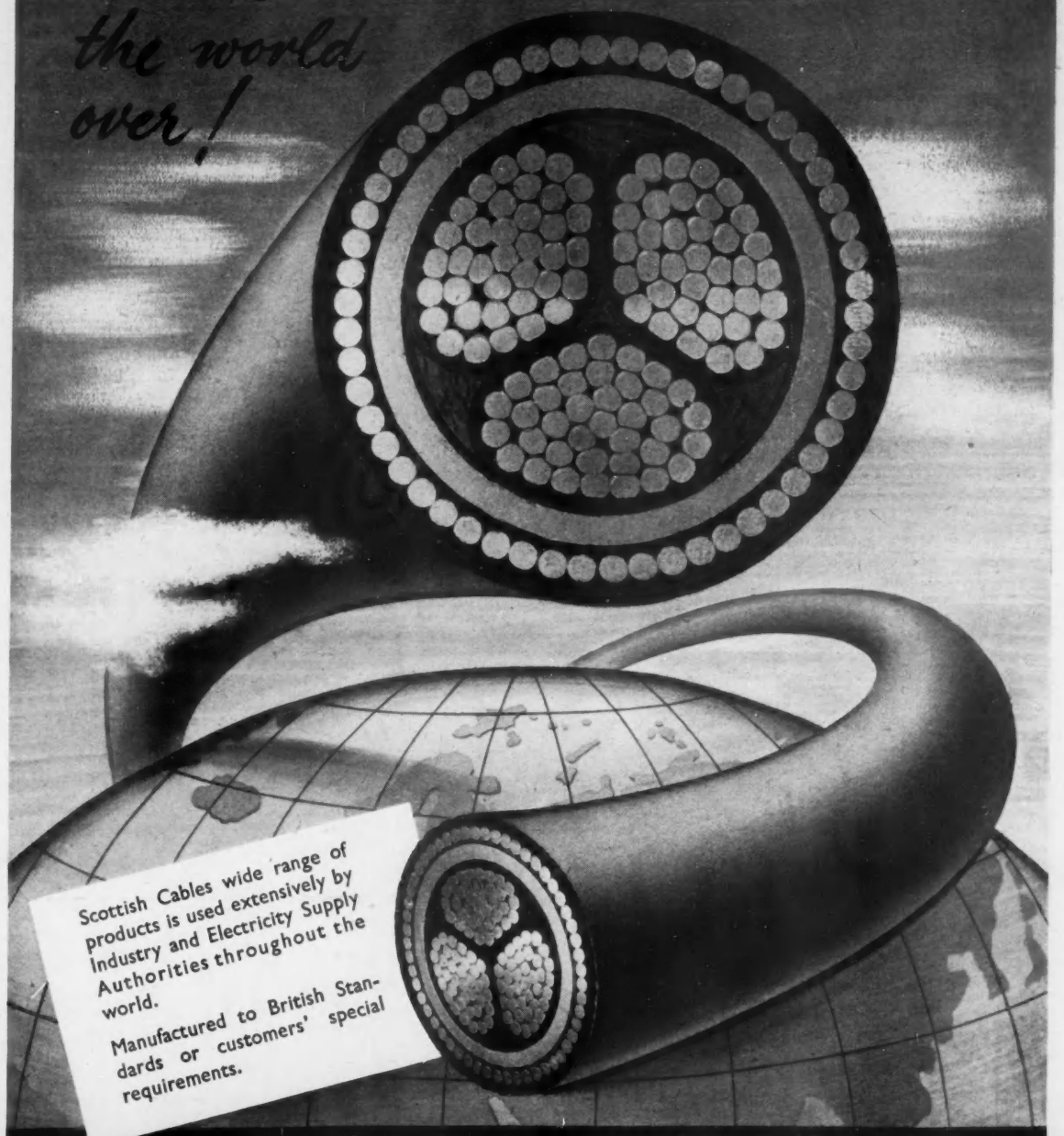

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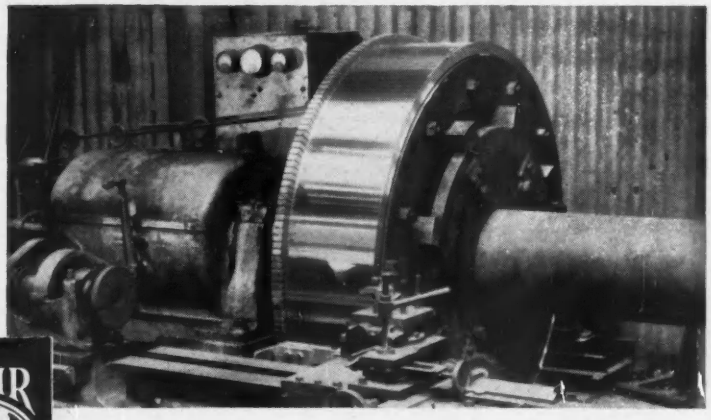
*Illustrated are two stages in the manufacture of a 6 ft. diameter solid riser type commutator. The Photographs show (top) the machining of the Vees and (bottom) after machining of the brush surface diameter.*



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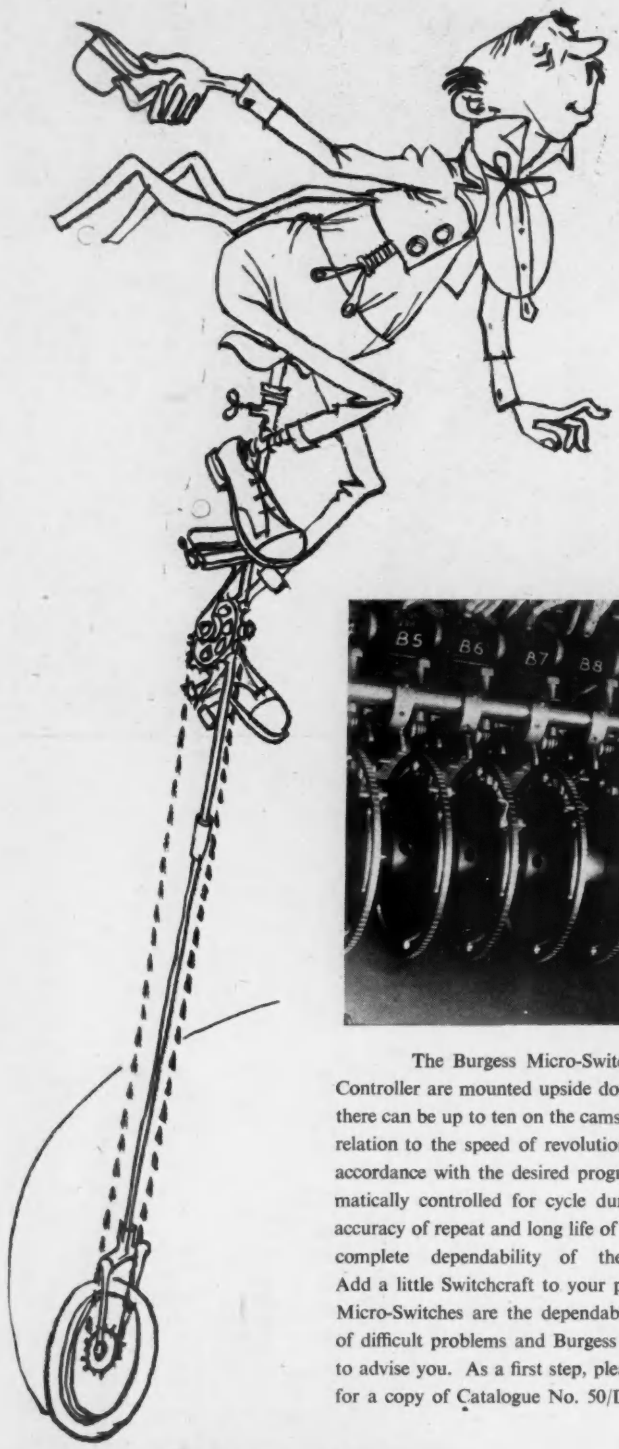
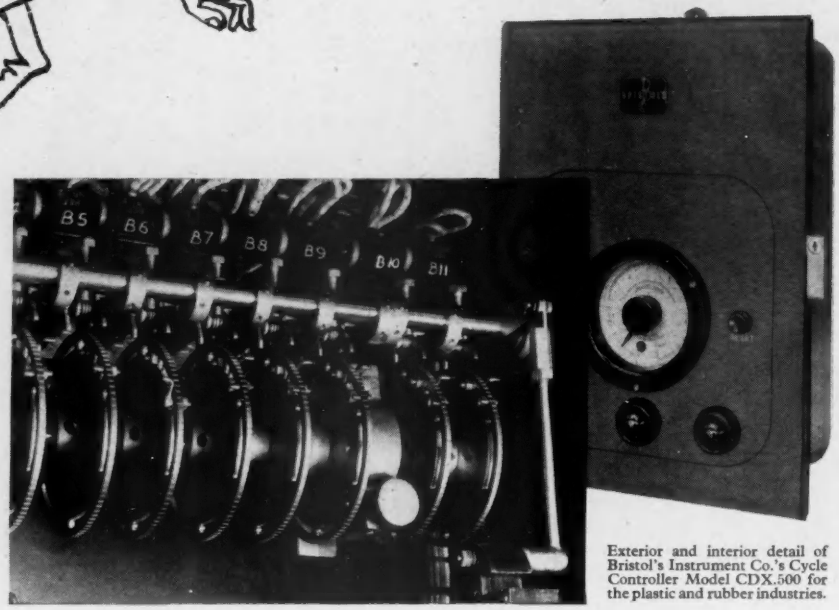


# Add a little SWITCHCRAFT to Cycle Controlling

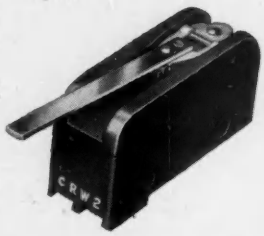



Exterior and interior detail of Bristol's Instrument Co.'s Cycle Controller Model CDX.500 for the plastic and rubber industries.

The Burgess Micro-Switches seen in the above photograph of Bristol's Cycle Controller are mounted upside down and are operated by dogs locked to cams of which there can be up to ten on the camshaft. The actuating devices are most carefully timed in relation to the speed of revolution of the camshaft to operate each switch precisely in accordance with the desired programme. In this manner up to ten processes are automatically controlled for cycle durations ranging from 20 seconds to 5 minutes. The accuracy of repeat and long life of the Burgess Micro-Switches are factors upon which the complete dependability of the instrument relies.

Add a little Switchcraft to your products too—Burgess Micro-Switches are the dependable answer to all sorts of difficult problems and Burgess engineers are waiting to advise you. As a first step, please write or telephone for a copy of Catalogue No. 50/D.

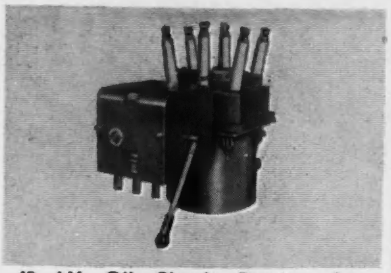
Type CRW2. The type of Burgess Micro-Switch employed in this application is a standard model available from stock. The strong actuating lever requires a force of only 1 oz. max. to operate.



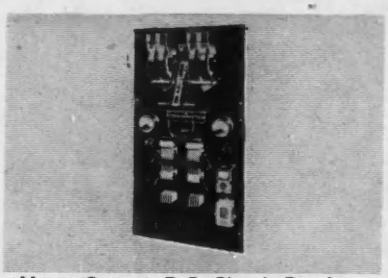

**BURGESS MICRO-SWITCHES**

*Industry's Automatic Choice*

BURGESS PRODUCTS CO. LTD., Micro-Switch Division, Dukes Way, Team Valley, Gateshead 11. Telephone : Low Fell 75322 (3 lines). Telegrams: MICRO, Gateshead.

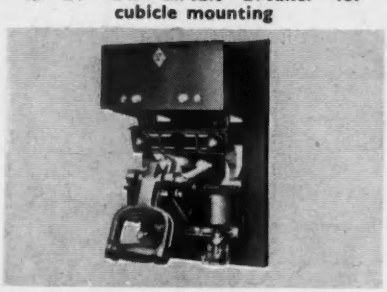


15 kV Oil Circuit Breaker for cubicle mounting

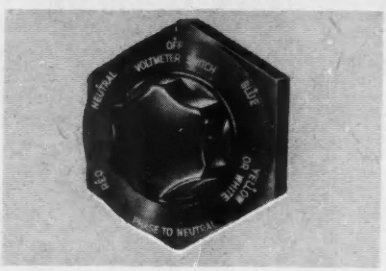


Heavy Current D.C. Circuit Breaker and Knife Switch Panel

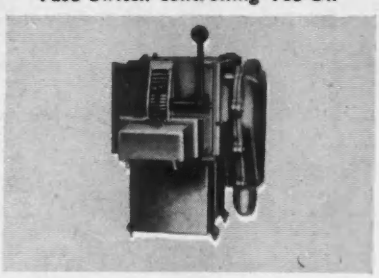
H.V. Ring Main Switchboard with Fuse Switch controlling Tee-Off



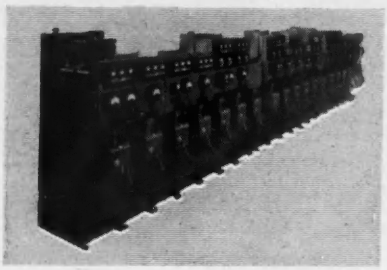
Small Air Circuit Breaker



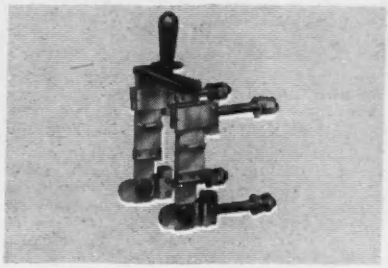

Ammeter and Voltmeter Switches



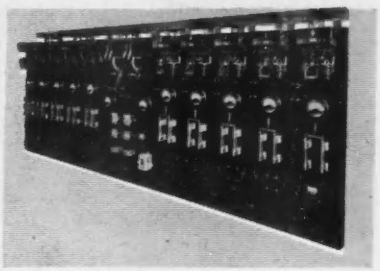
L.V. Industrial Oil Circuit Breaker



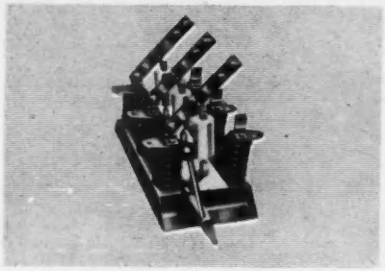
11 kV Metalclad Switchboard



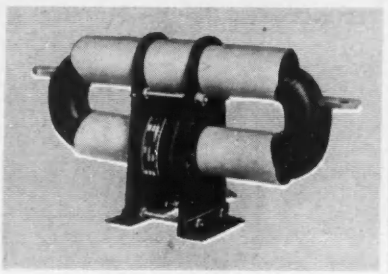
Panel Mounting Knife Switch



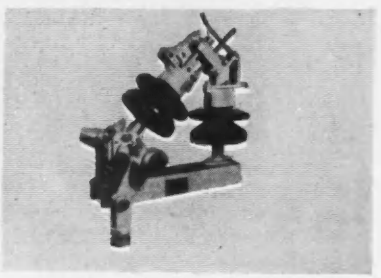
D.C. Switchboard for Steel Works



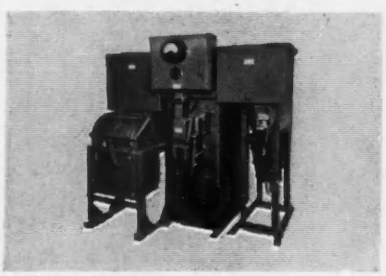
T.P. 11 kV Isolating Switch



Current Transformers



Outdoor Pole Mounting Isolators



H.V. Switchboard incorporating Automatic Fuse Switch

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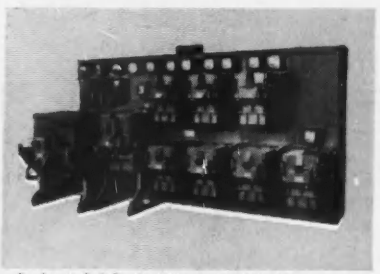

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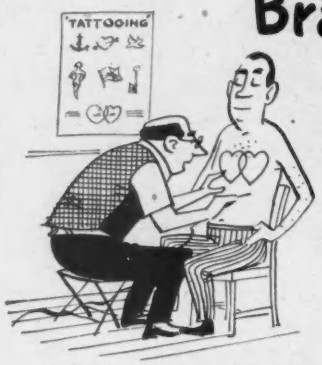


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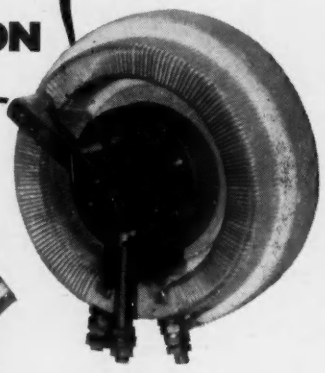
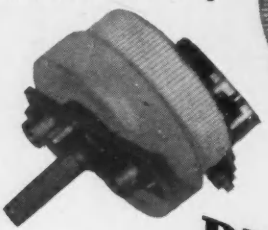


Size R.T. 50 Type Embedded of 50 wts. rating



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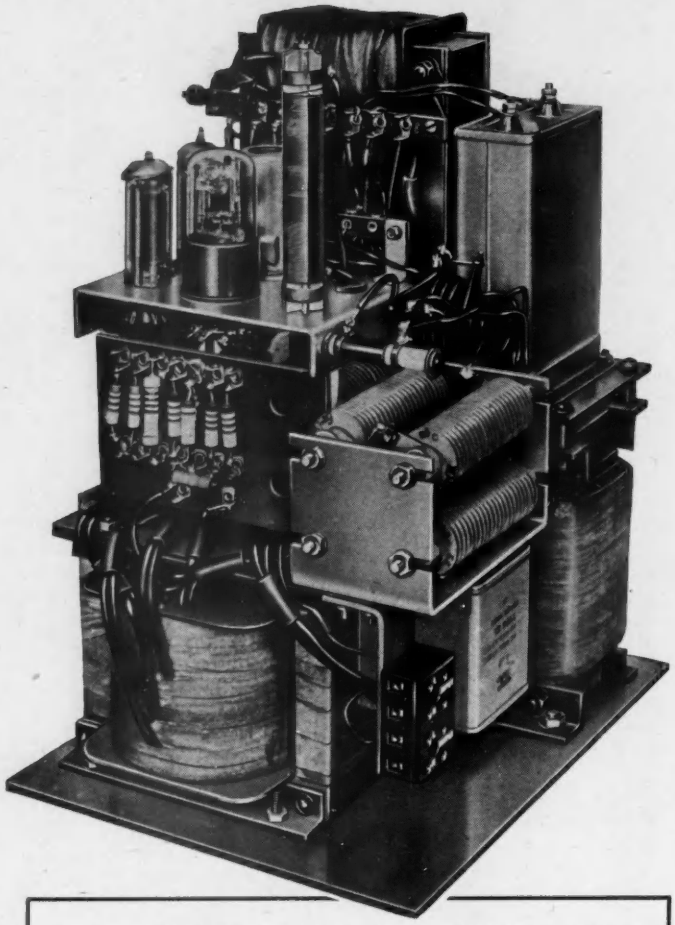
The problem of stabilising an A.C. source of supply for the varying needs of industry has up to now been only partially solved. There are several types of saturated core constant voltage transformers which satisfy some of the conditions, but these generally are frequency dependent and any additional compensating circuit for this feature renders the equipment load dependent. Also there are the electro-mechanical type regulators depending on the operation of a transformer tap-changing mechanism by an automatically controlled motor, the disadvantages of such circuits are the slow speed of response and the inconvenience of moving parts.

There are many applications in industry and communications where the disadvantages of the above circuits render them unsuitable. Such equipment as radar, photographic printing, spectrometers, electronic circuits and instruments containing illumination references call for a high degree of constancy of the mains supply under all operating conditions.

We have therefore developed a piece of static equipment capable of supplying a variable load with constant voltage irrespective of mains frequency and voltage changes. The equipment has been designed so that the output voltage has a low harmonic content, but in any case the R.M.S. value of voltage is maintained constant.

A potentiometer connected transductor circuit is employed while the control winding of the transductor is supplied from a voltage sensitive circuit incorporating a saturated diode.

A 1000 VA unit is now under development.



*The following specification gives the salient features of the performance of the set*

| | |
|---|---|
| **Mains frequency** | **40-60 cycles/sec.** |
| **Load** | **Zero to 500 VA maximum** |
| **Speed of response** | **5 cycles** |
| Input Voltage | 195-260 volts |
| Output Voltage | 230 volts ±0.25% |
| Regulation | 0.5% No load—Full load |
| Harmonic content of load voltage | Not greater than 8% |
| Physical size | 10½" × 12½" × 15" high |
| In sheet steel case | Weight 52 lbs. |

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A 'LANCASHIRE DYNAMO HOLDINGS' COMPANY

VR/5

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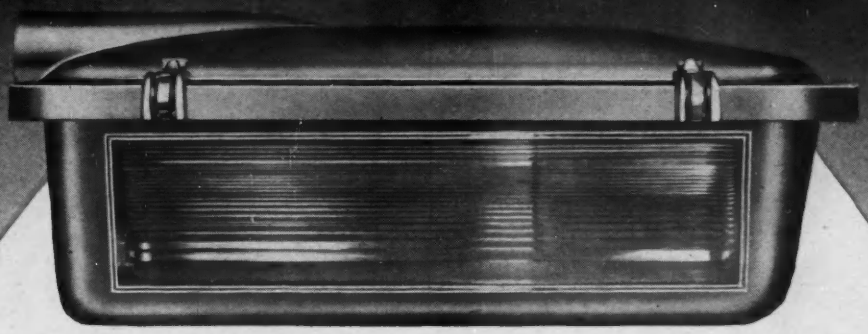

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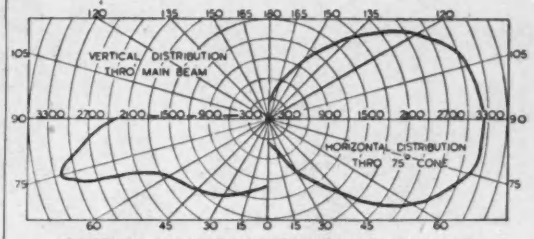
THE Golden Ray Mk. III is a solidly constructed lantern, for either side or top entry. Gives maximum light with a minimum of attention.

Its high optical performance is assured by an entirely new designed machine-cut "Perspex" prismatic refractor panel which ensures an efficient and balanced light distribution on the road surface. Years of trouble-free service are assured by its sound engineering construction. Its sturdy top casting is die-cast from aluminium alloy. The refractor panel is hermetically sealed to the interior surface of the "Perspex" enclosing bowl, whilst a heavy felt gasket placed between the bowl and top casting acts as a further barrier to dust and dirt. All exterior small parts are made of stainless steel.

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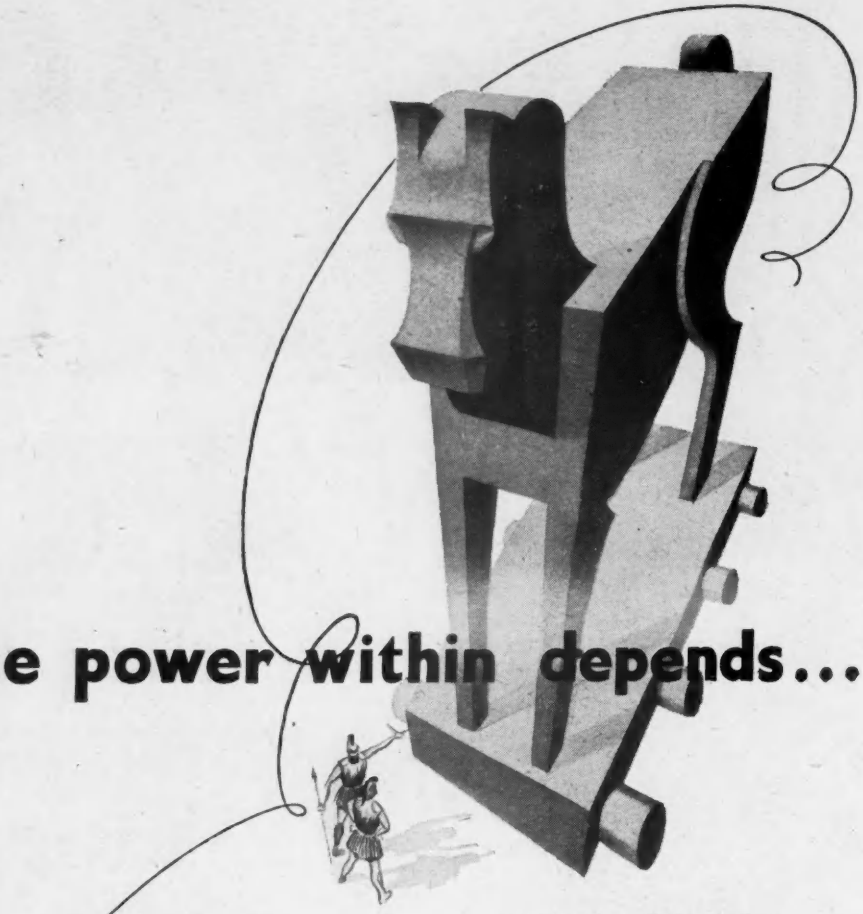

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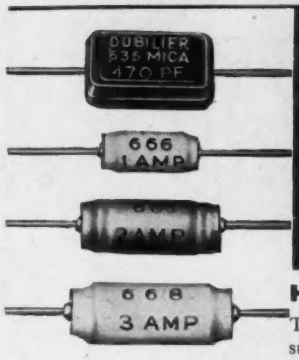
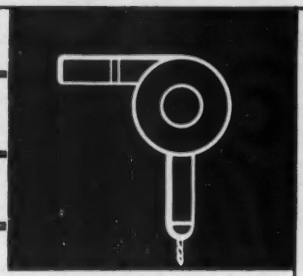
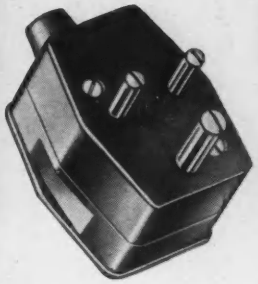


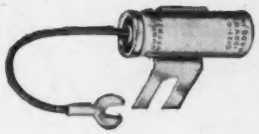
**HAIR DRYER**

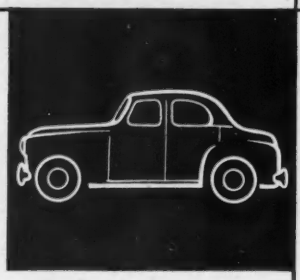
Television interference suppressor kit for all domestic appliances. 1, 2 and 3-amp.



**VACUUM CLEANER**

Radio interference 3-pin suppressor plug. 5-amp., 13-amp. fused and 15-amp.



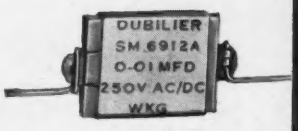


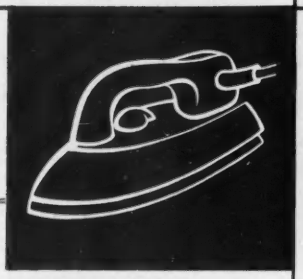
**MOTOR RADIO**

Radio interference suppressor for motor vehicles. Type SV.

**SEWING MACHINE**

Radio and television interference suppressor for electric sewing machine motors. Type SFK 40B.



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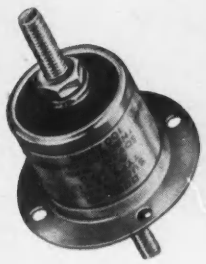

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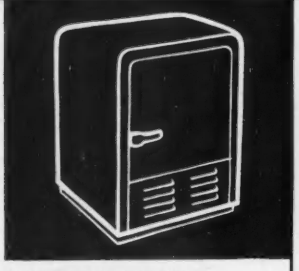

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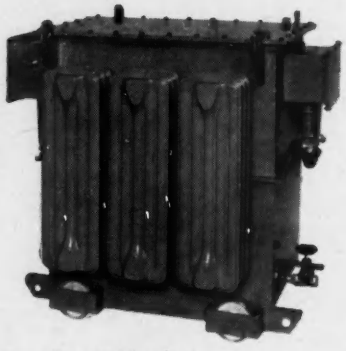

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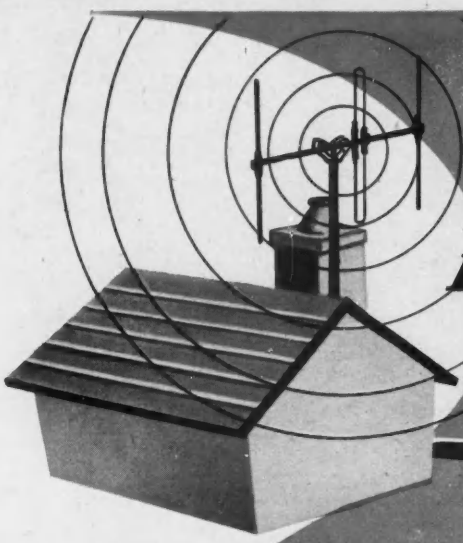

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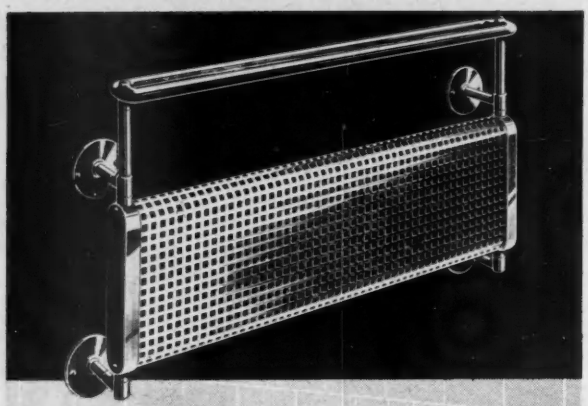

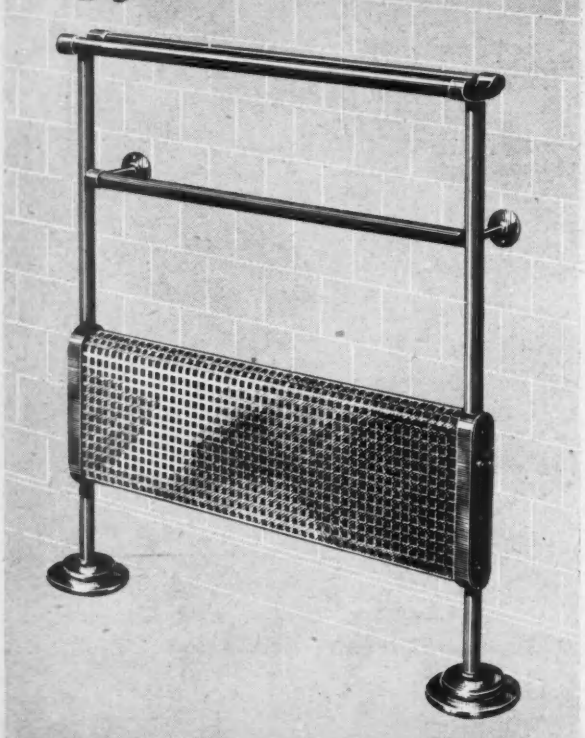

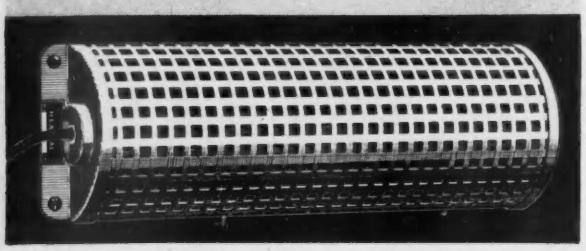

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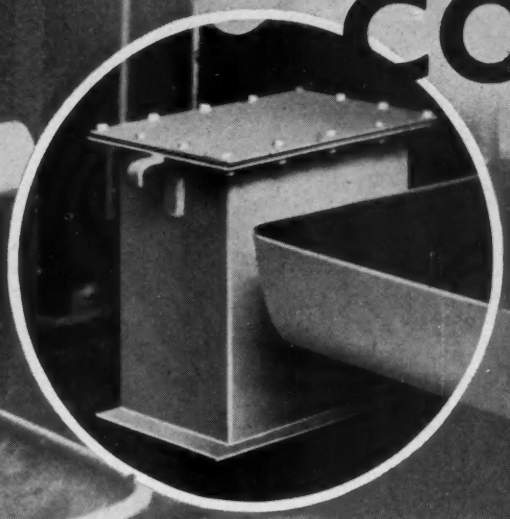

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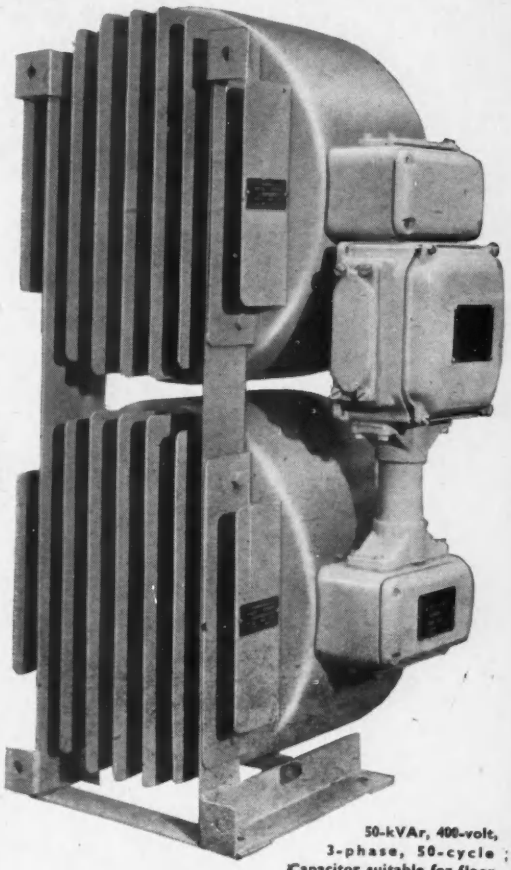

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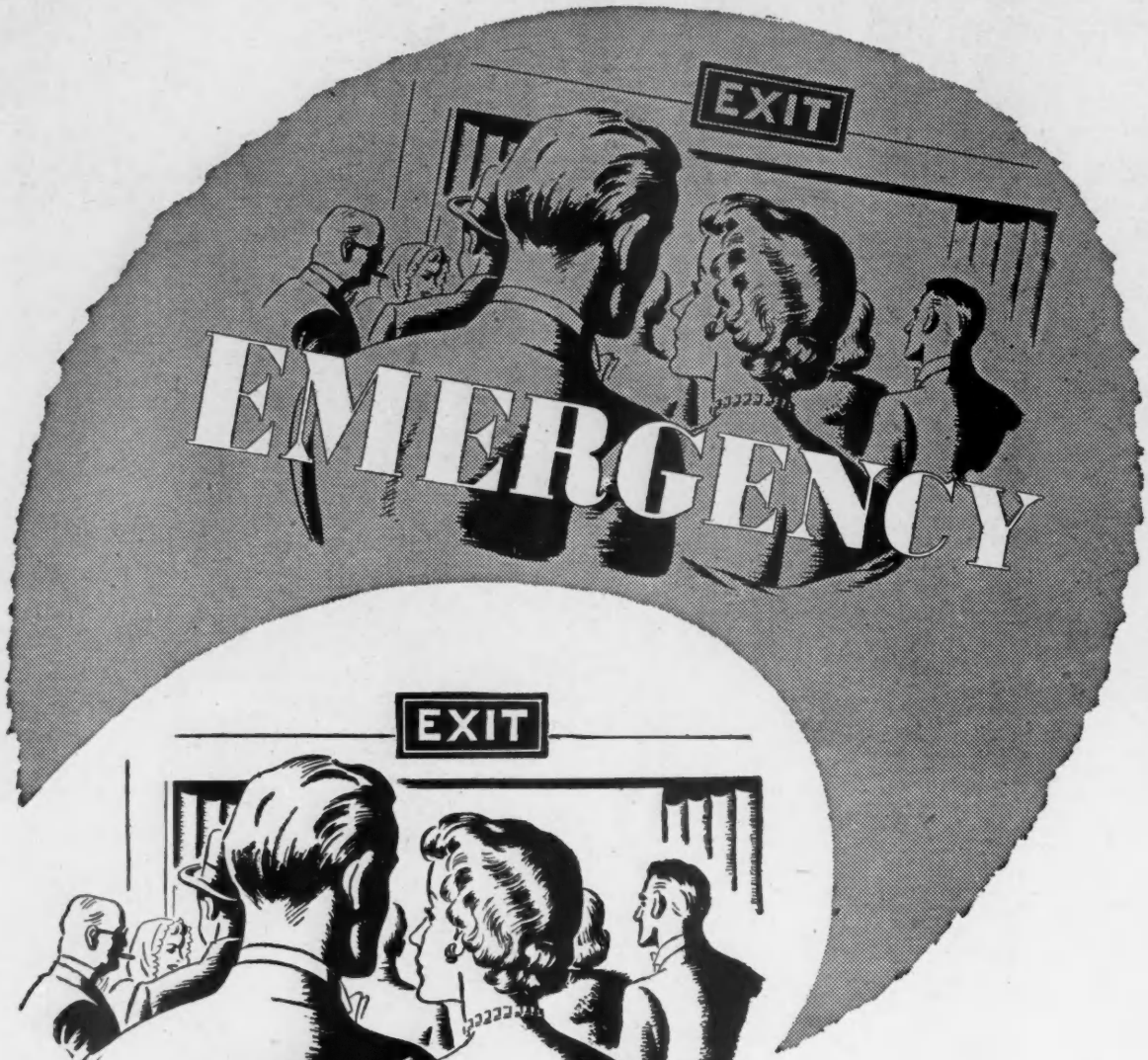


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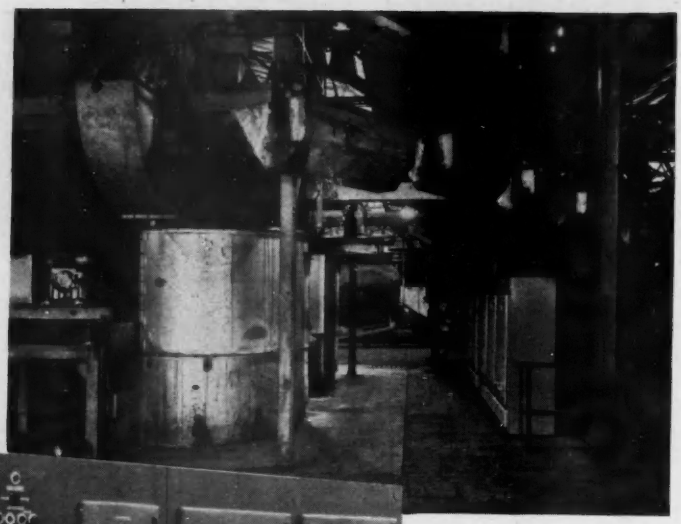
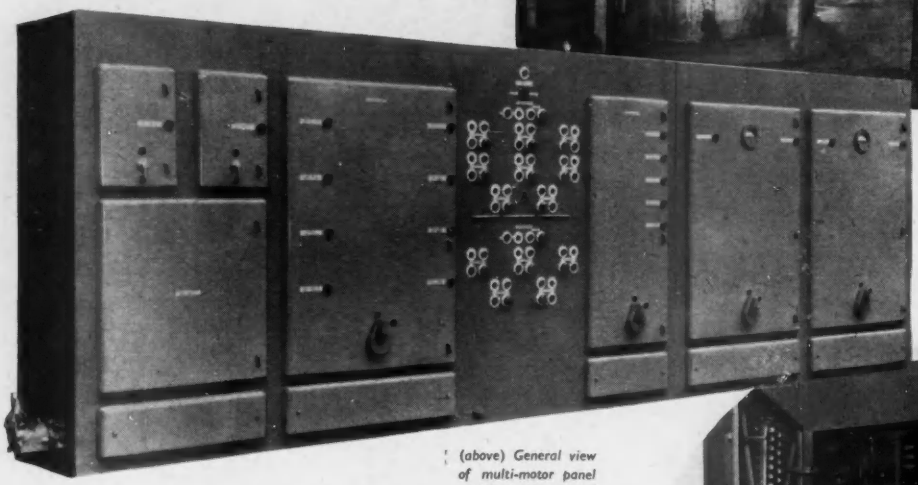
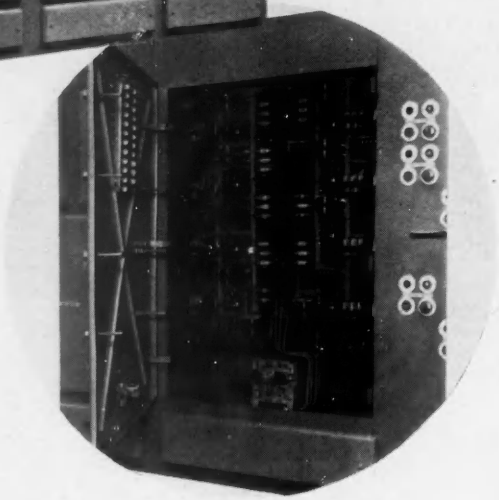




(above) E.A.C. multi-motor panel installed in the Ipswich foundry of Crane Ltd.

(above) General view of multi-motor panel and (right) interior of a section of the panel.



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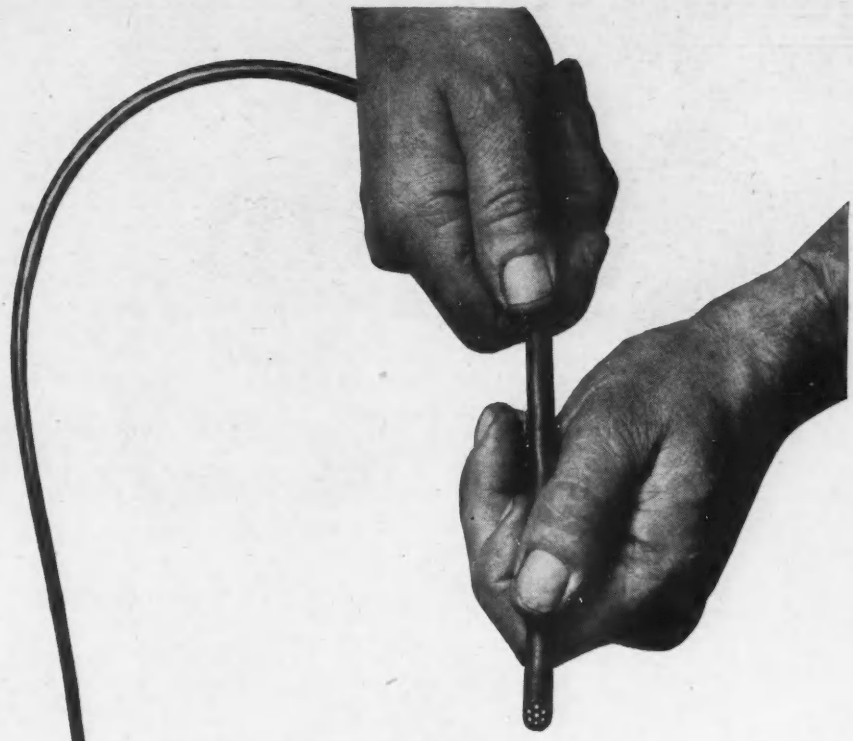

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# ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 16 DECEMBER, 1954
Volume No. 126 Number 3293
REGISTERED AS A NEWSPAPER

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2.
Telephone: HOLborn 6016
Telegrams: Equivolt, Estrand

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United Kingdom and Overseas £2. 10s. 0d. per annum. Canada $7.50, U.S.A. $7.50 per annum. Subscriptions are payable in advance and may commence with any issue throughout the year. Overseas subscriptions may be paid to The Electrical Times Limited by banker's draft, cheque or international money order. Single copies price 9d. each.


## UNTIMELY INVESTIGATION

Once more the Board of Trade has picked on a branch of the electrical industry for investigation by the Monopolies Commission. This time it is the supply of electronic valves and cathode ray tubes that has been referred "for a report on the facts and their bearing on the public interest." This brings to four the entirely electrical subjects that have been before the Commission, out of only nineteen past and present references. Reports on lamps and cables have already been published, and the work on electrical and allied machinery must now be near completion. The new reference will continue the unnecessary tradition which seems to be established, that there must always be an electrical subject before the Commission. Why has the Board of Trade so close an interest in electrical engineering? The industry is, of course, well organised. Unlike some traditional industries it has been built on a foundation of scientific investigation with all that entails of a relatively free exchange of information, rather than close preservation of some mumbo-jumbo of trade secrets. Commercial rationalisation has inevitably gone hand in hand with technical co-operation. It seems to be the opinion of the Monopolies Commission and those associated with it, that the two are separable; indeed a most doubtful proposition. Five years of probing into the electrical industry has been the result, and this has placed a heavy burden on senior officials; indeed, as a B.E.A.M.A. spokesman has pointed out in relation to the investigation affecting that Association, it has diverted effort from the task of export selling, a result in itself contrary to the public interest. Considered in this light, this latest reference seems basically unjustified at the present time, the more so since the Commission is in any case currently considering generally the whole question of discriminatory practices and their desirability.

## 300 MW PUMPING FOR THE PEAK

Renewal of the British Electricity Authority's application to Parliament for powers to carry out a new North Wales Hydro-Electric scheme will doubtless give rise again to strong opposition from amenity zealots. However, the Authority has abandoned the more contentious proposals of its earlier plan, notably the headwater diversions in connection with the Rheidol scheme, and there should be a good chance that the private Bill concerned will have a safe if somewhat stormy passage. Indeed, the proposals come at a time when it appears more than ever necessary to make use of the marginal energy resources in this country to tide over

the increasingly difficult fuel situation likely to exist until large scale nuclear power becomes a reality. Yet it is not only as a source of energy that the present scheme is of interest: in its Ffestiniog proposals it gives special emphasis to the peak-load problems of the country's supply system. As a contribution to easing these, the Ffestiniog station is planned as the first large scale pumped storage scheme in Great Britain. Centrifugal pumps as well as water turbines will be connected to the shafts of the 50 MW alternators, and these machines will be designed for running as either motors or generators. During off-peak periods water will be pumped back from the discharge pond to the upper reservoir, some 1,000 ft above the water turbines, energy for this operation being obtained from the supply system generally. At peak hours, Ffestiniog can then work to the full extent of its 300 MW ultimate capacity, without undue concern with the way the reservoirs are drawn upon. Since Ffestiniog is to be connected to a spur on the 275 kV Supergrid, the extra capacity thus offered will be of value to the country as a whole. It is this which must account for the low load factor of 11% envisaged for the scheme. This cost will give an interesting measure of the worth of peak kilowatts.

## CHOICE IN ENGINEERING

A House of Lords debate on technological education last week, concerned as usual with the quantity and quality of engineers, provided a convenient occasion for a further statement of Government policy on training facilities at university level. The decision to avoid the separate technological university and concentrate instead on expansions in the facilities for engineering and science studies in more conventional establishments was confirmed, and strengthened with a promise of more money and faster progress. Beyond this overall question of the form higher education is to take, however, there lies a problem of proportions: how many technologists in each category? Investigations of the Institution of Electrical Engineers into this subject have already led to the conclusion that electrical engineering is not receiving its equitable share of the best of school-leavers and graduates, and there is as well some question of the real sufficiency of the overall supply of electrical engineers. Rearing its head too, is a problem still less tractable. Is a reasonable proportion of those who study electrical engineering aiming for a "power" career as distinct from one in "communications and electronics?" The evidence is increasing that it is not, and that something of a shortage is developing in the power field. There is ominous support for such a reading of the situation, in the similar experience that has afflicted heavy electrical engineering in the United States. Electrical power engineering cannot offer the glamour of electronics, nor the same excitement of being on the crest of a great wave of new technological creativeness; but the older branch of the profession has many compensations. How to make a career in power engineering, including supply and manufacture, more attractive to the young entry may, however, before many years, become a major concern of the industry.

## LAMP LIFE CONSISTENCY

Lamp life has been increased steadily in the past few years notably in respect of fluorescent and discharge lamps. Such progress brings obvious advantages for the lamp user, but there are other improvements which have been occurring at the same time whose importance is less readily appreciated. Outstanding amongst these is enhanced uniformity in quality, as denoted by a smaller spread in the life of lamps operated under similar conditions. Such improved uniformity means that the user "knows where he is." In particular, it makes more attractive the operation of group replacement schemes, such as are common in street lighting practice. On occasion these can effect a saving of several shillings per lamp in replacement cost, as compared with the more common practice of replacement on failure. The advantages of such schemes are discussed in some detail in a paper which Messrs W. Robinson and J. W. Strange presented on Tuesday to the Illuminating Engineering Society. These authors suggest, on a basis of study of a wide range of industrial and commercial installations, that where sheer size of installation is important, or where fittings are relatively difficult of access, the cost of labour for group replacement may be as low as 20% to 30% of that for individual lamp replacement. This saving is sufficient to make study of such schemes a worth-while exercise for plant engineers generally.

## NOVELTY IN SPEED CONTROL

Nothing has occurred in electrical machine design to match the sweeping advances achieved by electronics and communications engineers. The story has rather been one of steady and valuable advances in the technology of manufacture and application. This adds piquancy to the temporary excursion into fifty cycle company of Professor F. C. Williams who last week with a colleague presented a paper to the Institution of Electrical Engineers, not on his familiar topics of radar or of electronic computation, but on a radically new conception of a variable speed induction motor with a solid rotor. The idea is simple enough in principle: stator pole pieces each carrying a multi-pole three-phase winding are twisted relative to the rotor axis to give continuous speed variation. Complications of rotor winding of commutators or of slip-rings are rendered unnecessary, and the possible ratio of maximum to minimum speed made available is attractively large. Of course, there is a deep chasm of difficulty between the demonstration that such a bright idea will work in a relatively small, low efficiency machine, and its eventual emergence as a technically practicable and commercially attractive range of motors. Certain inherent difficulties exist which may indeed restrict the new motor largely to the role of curiosity, but there is nothing wholly impracticable about it, and it is well worth further attention and investigation. Its appearance is an invigorating event in a field that has been generally quiet for many years now.

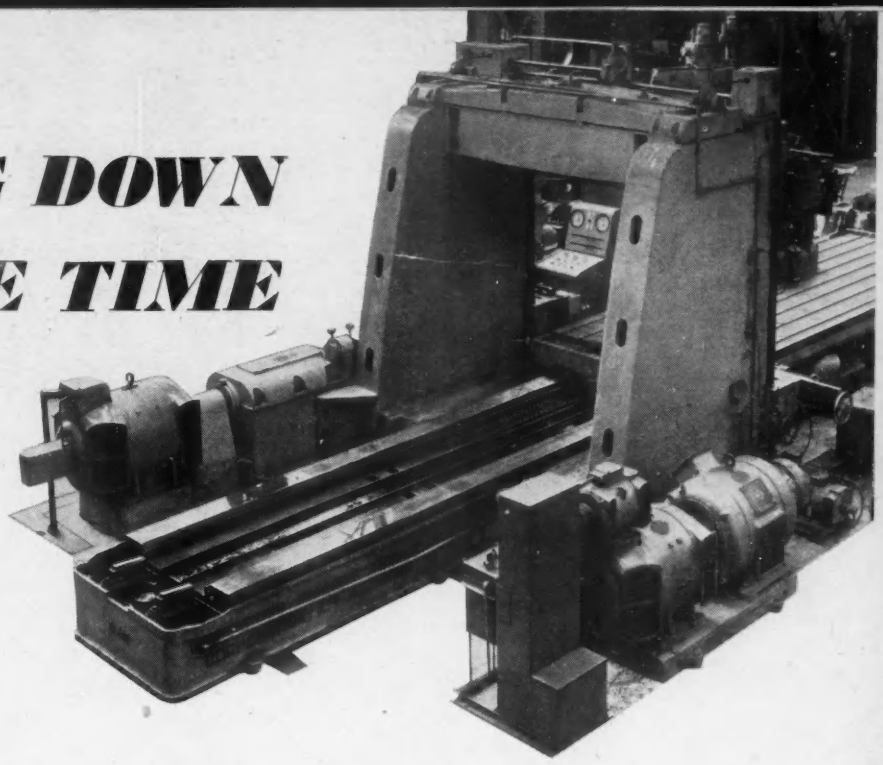
Meteor

Electrical Times, 16 December, 1954

# CUTTING DOWN MACHINE TIME

## Electronic Control offers Increased Flexibility and Provides Fuller Utilisation

By J. SHAW *



*General view of Loudon planer with Ward Leonard set in foreground. The control desk can be seen between the side members*

THE war years and conditions since have demanded that all machine tools should be used to the limits of their capacity. Both jig and tool engineers have exercised their ingenuity to reduce to a minimum the setting-up time. Further, when new alloys are produced their "machineability" is an important factor in the assessment of their qualities, and a great deal of research has been undertaken to determine the optimum tool angles, tool materials and cutting speeds for old and familiar, as well as new metals.

Planers are no exception in this urge for greater productivity and it is not surprising that the drive of these reciprocating tools should have been subjected to much consideration in recent years.

### *Drive Fundamentals*

Although several methods are available for driving these reciprocating tools, by far the most popular since its inception in 1909 by Lancashire Dynamo, has been the Ward Leonard type of Planer Drive. The Lancashire Planer Drive has been progressively improved over the years and many features added but the fundamentals of the drive have remained the same. These are briefly stated below.

The table-driving motor has its direction of rotation determined by the direction of the generator excitation and its speed determined by the magnitude of the generator excitation and also its own field excitation. Switches operated by tappets moving with the planer table select, via contactors, the required magnitude and direction of the field excitations. Two or more speed regulators are provided. One regulator controls the speed during the cutting stroke, and another controls the speed (usually greater) during the idle return stroke. A further regulator may be provided which regulates the speed during one or more portions of the cutting stroke. This device is useful for the following reasons: (*a*) Where planing surfaces with gaps between them, the gaps can be traversed at a higher speed than is used whilst the metal is being cut. (*b*) The tool can be made to enter and leave the surface at reduced speed thereby reducing shock at the tool and job. Badly broken edges of planed surfaces are thus avoided and tool life is often increased. (*c*) The speed can be reduced when planing a local hard area of metal.

The feature described above has come to be known as the "accelerating" device. A "retarder" device is sometimes adopted, particularly where the work involves planing up to a shoulder. In such cases it is important to ensure that the point of reversal is not altered when the speed during the main part of the stroke is altered by the operator. This device is arranged to drop the speed to a low value immediately before the reversing switch is engaged by its tappet.

### *Auxiliary Drives*

In addition to the main drive on a planer, some means must be provided for actuating the feed. This is an intermittent motion, as opposed to the continuous feed motion of a lathe. The tool must be moved by an adjustable amount immediately prior to cutting metal on each working stroke. If a motor is used to drive the feed transmission then the motor must be made to rotate by a definite number of revolutions and fractions of a revolution, including accelerating and stopping, just before the commencement of each cutting stroke. The number of revolutions and thus, the amount of feed applied, must be adjustable by the operator. Numerous ways, both electrical and mechanical, have been adopted in the past for providing the feed drive and it is essential that special consideration be given to ensuring rapid and accurate application of the feed.

Among other devices fitted on planers and acting in conjunction with the drive are tool-lifting solenoids which, when energised on the idle return stroke, lift the tool tip clear of the work. Damage of tool and work caused by trailing of the tip on the work is thereby avoided. Various small motors are often adopted for raising and lowering

* Lancashire Dynamo and Crypto Ltd.

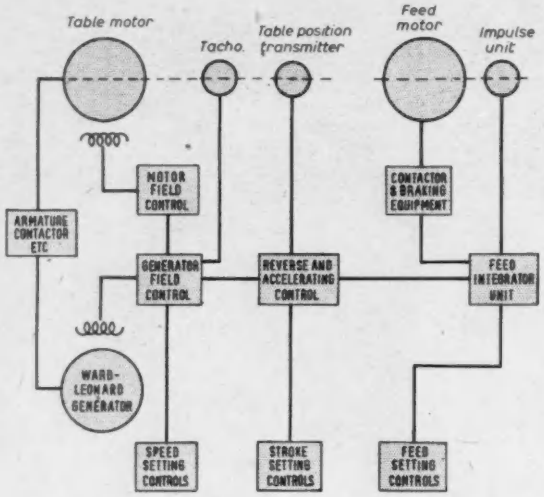



*Fig. 2. Block schematic diagram of control system*

the cross slide, rapid traverse of the tool boxes (although these functions are frequently dealt with by the feed motor), the driving of oil pumps, cross slide locking mechanisms, and to perform other auxiliary functions.

## *Electrical Considerations*

When a new Loudon Planer was installed at the L.D.C. Trafford Park Works, this afforded an opportunity of adopting a drive embodying closed loop techniques—a field in which Lancashire Dynamo Electronic Products Ltd., are well-known.

Considering firstly the table drive, the fast cutting and return speeds possible on modern planers will not give an increase in production if the reversal at each end of the stroke is sluggish. During each reversal the kinetic energy of all the moving parts must be absorbed by regeneration of the motor, then the kinetic energy is reinstated during acceleration in the new direction. The reversing time varies inversely as the motor's average torque which, for fixed field current, is almost proportional to armature current. The heating loss in the motor is a function of the square of the r.m.s. torque multiplied by the reversing time. Thus, the nearer the r.m.s. torque approaches the average torque, the more efficient the reversal, the ideal being reversal under controlled constant current conditions. A further consideration inherent in all motors is that the torque produced at high armature currents does not rise proportionally to the current owing to armature reaction. Thus high peaks of armature current during reversal should be avoided. Lastly, reversal under constant controlled torque imposes the least onerous conditions upon the gearing and structure of the machine tool.

## *Application of Electronic Techniques*

On this planer, which has an eight-foot gap between housings, and is six feet from table to fully-raised cross-slide tool tips, with eighteen feet maximum stroke, (illustrated in Fig. 1), thyratrons have been used to supply the motor and Ward Leonard generator fields. The thyratrons are controlled by electronic amplifiers operating on the closed-loop principle, which is becoming increasingly well-known. The speed regulators are, in effect, potentiometers which select a stabilised voltage proportional to the required speed. This voltage is compared with a voltage proportional to the actual speed of the planer and the error, suitably amplified, is used to adjust the circuit conditions so as to reduce the error. Overriding this control is the armature current limit control. A voltage proportional to armature current is obtained from the voltage drop across the motor interpoles.

The generator field winding is in two portions, each portion excited from a separate pair of thyratrons so as to give two opposing m.m.f.'s. The two pairs of thyratrons are in phase opposition. By this arrangement, control of the generator field between maximum in one direction and maximum in the other direction can be obtained without discontinuity. The motor field thyratrons are controlled by a separate amplifier which is coupled to the generator field control amplifier in such a way that full motor field is established whenever the generator voltage is below its working maximum. The block diagram (Fig. 2) indicates the control scheme.

As mentioned previously, most planers have their points of reversal and speed changes during their working stroke controlled by switches, which are operated by tappets mounted on the edge of the table or on a dial. On this new drive, adoption of the new techniques has eliminated these switches together with their operating tappets which are sometimes a danger to the operator. Instead, a mimic set-up at the control desk enables the operator to set the points of reversal and speed change by sliding model "tappets" along a scale representing the table. These model "tappets" are ganged to a potentiometer in the desk, and a second potentiometer is also driven by the table. Thus when the table position potentiometer voltage agrees with the desk "tappet" voltage, a relay is operated by the

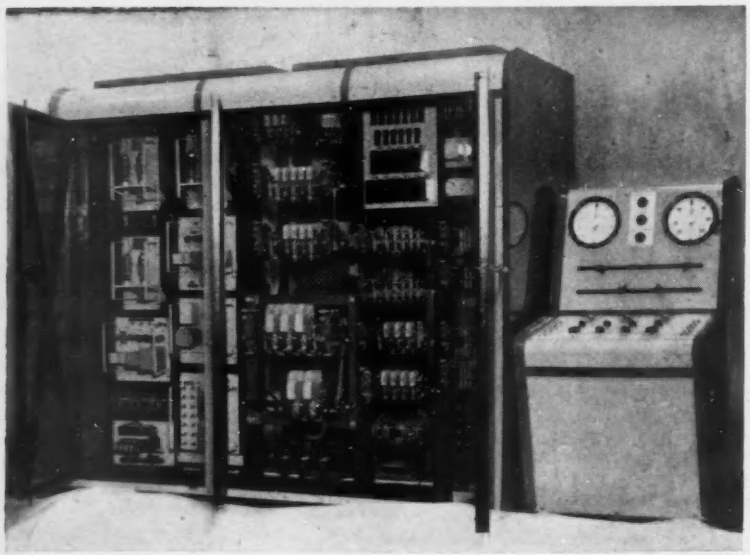


*Fig. 3. Close up view of contactor and control cubicle. The operating desk is on the right and shows the setting position*

positional control amplifier to effect the required change in circuit conditions. Fig. 3 provides a general view of the control desk and cubicle.

The feed drive comprises a slip-ring motor having an "impulse unit" integral with it. This impulse unit is a device for supplying a number of impulses, proportional to the angular displacement of the feed motor, to an electronic integrator in the panel. It, consequently, produces a voltage proportional to the amount of feed and compares this with the amount of feed required. When the required amount of feed has taken place the feed motor is stopped by polarised braking. The feed motor is used also for quick traverse of the tool boxes and cross-slide elevation.

Maintenance of the electronic equipment is simplified by incorporating the smaller components into plug-in chassis, some of which are interchangeable with others within the same equipment. The machining time of jobs involving fairly short stroke operation, has been reduced by as much as 12½% in some cases. During the planing of bedplates where two pads are being planed, having a space between, which can be traversed at high speed, the rapid acceleration and retardation obtained on this planer has often reduced machining time by 10%.

In conclusion this drive indicates that the adoption of electronic techniques on planer drives is technically practicable, and certain advantages accrue. Apart from the equipment discussed above, a similar drive has recently been successfully commissioned in Canada.

# *Prospects of Atomic Energy*

## *Possibility of Power Production in the Near Future*

A SURVEY of the power and fuel situation was given to the London Local Group of the National Technical Groups of the Electrical Power Engineers' Association last week, when Dr S. G. Bauer gave a lecture on "Fuel Resources and Atomic Energy." Dr Bauer began by giving a résumé of the development of power consumption in this country and emphasised that coal production had remained virtually constant since the turn of the century. At the moment practically the whole of the coal output was utilised within Great Britain, and any increased demand from power stations would have to come from the requirements in other fields. At the present rate of production it was estimated that in 50 years the difficulty of raising coal would become such as to double the cost. A solution would be the use of atomic energy to take some of the load.

### *Reactor Design*

The atomic energy programme put engineers in a dilemma, as the plants for war purposes were put up regardless of expense, while commercial use implied that cost had to be considered. There was a large number of reactor combinations available—possibly 125 practical variations—and a selection of these left about ten which showed high promise.

Existing work was available on the natural uranium reactor using heavy water as a moderator. This was comparatively small, about 10 ft in diameter by 10 ft high, but required 20 tons of heavy water, a most expensive item.

Graphite could be used as a moderator, but meant that the pile size went up to a 30 ft cube, and required about 1,000 tons of graphite.

By using the isotope U235 instead of U238, the field widened as U235 had a good minimum size and could also be used to provide plutonium. This type of reactor—the breeder reactor—had interesting possibilities. It needed, however, pure fissile material and although its critical size was about that of a football, the material worked out at about £30,000 per lb. It was also difficult to extract large heat quantities, up to 100 MW, out of such a small volume. Further, the critical size was really critical, and as fissile material was used up it had to be replaced—a difficult task.

The highest temperatures one could obtain using graphite as a moderator in a normal pile was about 300° C, and after considering temperature gradients the actual working temperature available was much less. In Calder Hall, carbon dioxide had been selected as a heat transfer medium.

A number of projects had been considered using water as a moderator, and *"Nautilus"* used high pressure water which was flashed into steam for driving the turbines. One of the troubles of using high pressure water was that corrosion of pipes was greatly accelerated by the radioactivity in the water.

### *Liquid Metals*

In large reactors, water tended to absorb too many neutrons and it was preferable to use liquid metals such as sodium or sodium cadmium alloy. This was less corrosive than high temperature water. Handling such metals posed severe technological problems. Normal valves or pumps, for instance, could not be used. An electrical pumping attack had, however, been developed which had an efficiency of 30 to 35%. The heat transfer with liquid metals was fantastic, a heat exchanger the size of a fairly large table being able, with sodium/sodium, transfer to handle the entire output of Battersea power station.

In conclusion, Dr Bauer considered that the breeder reactor had a possibility for base load working, and he thought that small high-pressure reactors might be operating before the large commercial breeding piles. It was unlikely that atomic power would play a significant part until 15 to 20 years time.

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### U.S. ATOMIC POWER STATION PROJECT

It has been announced that as part of the U.S. Atomic Energy Commission's five-year nuclear power project, a 25 MW atomic power station is to be built to give 20 MW as heat and 5 MW as electricity. The reactor will use slightly-enriched uranium fuel, and will be moderated and cooled initially with ordinary water. Construction is to start during 1955 and completion is scheduled for 1956.

The parent company responsible for the design, development, construction and installation is Allis-Chalmers Manufacturing Co., of Milwaukee, Wisconsin, and under the contract, the company was to design and develop components with special sealing devices to prevent all leakage of steam air and water. If this can be performed successfully the use of heavy water will become a practicable proposition, with resultant economy in cost of output.

It is emphasised that the Experimental Boiling Water Reactor is to be regarded as a small-scale pilot plant only and the electricity produced will not be competitive with that from large central station plants. However, it is expected that the information gained from its construction will contribute immeasureably toward the ultimate goal of commercial nuclear power.

# PLANS FOR NORTH WALES HYDRO POWER

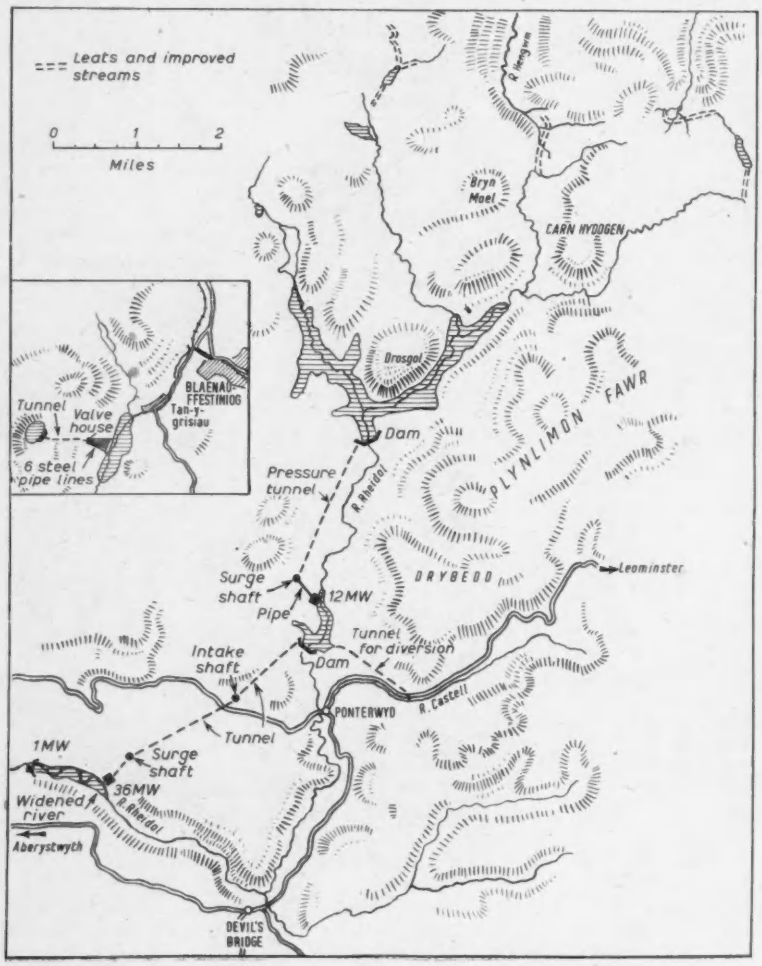
**B.E.A. introduce Bill for modified Ffestiniog and Rheidol Valley schemes**

PERMISSION to go ahead having now been obtained from the Ministry of Fuel and Power, the B.E.A. published last week the private Bill which they are to promote in the present Parliamentary session for the development of the Ffestiniog pumped storage and the Rheidol hydro-electric schemes in North Wales. The Bill, if authorised by Parliament, will confer upon the B.E.A. powers to construct and erect works and generating plant in the two districts to increase its installed capacity by 349 MW, and will carry the title of the North Wales Hydro-Electric Power Act, 1955.

Concerning the Ffestiniog scheme, the Bill will empower the Authority to build a dam across the River Stwlan at the point of its emergence from Lyn Stwlan to raise the level of that lake sufficiently to provide power to operate the six water-wheel sets to be installed in the station. A pressure tunnel will then convey the water from Lyn Stwlan to a valvehouse some two-thirds of the distance between the dam and the station. From the surge shaft six steel pipes then carry the water the rest of the way to each of the sets. The outflow from the turbines—which will be probably of the Francis type—is to discharge into a lake formed by a dam across the River Ystradau at its junction with the Cwmorthin. As may be recalled, the Ffestiniog scheme is planned to provide power at peak periods only, when 300 MW will be available by the discharge from Lyn Stwlan over a head of approximately 1,000 ft. At off-peak periods the water discharged into the lower lake will then be pumped back up to Lyn Stwlan. For this purpose the sets will be capable of both generating and motoring, whilst the shafts will carry both water wheel and centrifugal pump.

For the Rheidol scheme, which is far more extensive although only 49 MW of plant is involved, three dams are to be constructed. The uppermost, 150 ft long will span the River Rheidol about half a mile down stream from its affluence with the Camdwr. Water from the reservoir so formed will then be conveyed by tunnel to a surge shaft, and from there by a short surface pipe to the first station which will have an installed capacity of 12 MW. This station discharges into the second reservoir, formed by a dam across the Rheidol just below the point at which the Lant Dinas enter it. From this intermediate reservoir a tunnel conveys water to the lower station (36 MW) which is to be located on the Rheidol near Rheidol Falls. To equalise the intermittent discharge from this station, the Rheidol is again dammed a little way below the station to form a balancing lake, the head so formed to be utilised for powering the remaining 1 MW set.

The present Rheidol scheme is thus completely different from that proposed originally, and which met considerable opposition. Only the head waters of the Dovey are to be diverted three leats being provided for. The water of the Castell River will also be diverted, before it flows into the Rheidol, to flow into the intermediate reservoir. The Bill requires the Authority to maintain water flow meters at certain points, and to make good any diminution in water supplies for agricultural or domestic purposes.




*This map shows the works to be undertaken by the British Electricity Authority in the Rheidol and (inset) Ffestiniog hydro-electric schemes as laid out in the Bill*

# Stator Twisting gives variable speed

## NEW DESIGN PRINCIPLE FOR INDUCTION MOTOR

SIMPLICITY is the great merit of the squirrel-cage induction motor; its drawback is the difficulty of obtaining from it a variable speed characteristic. A new approach to this problem is suggested in a paper* which was presented to the Utilisation Section of the I.E.E. on Thursday last. This is essentially the use of machine in which the angle between which stator and rotor axis can be varied, in order to produce a variable speed.

The proposal for such a motor has arisen from the interest in "linear" three-phase motors of the type used for launching aircraft and pumping liquid metals. In such a motor the stator has effectively the winding of a normal cylindrical machine opened out flat. The magnetic field developed travels with a linear velocity $v_s=2pf$ feet per second where p is the pole pitch in feet and f the frequency in c/s. If an infinite but weightless conducting sheet were placed over such a stator, eddy currents would flow and the effect would be to move the sheet at velocity $v_c=v_s$ in the direction of field travel. If it moved more slowly power would be drawn from the supply, and work performed. But suppose the sheet were constrained to move at an angle to the field direction: what then?

### *Experimental Results*

Experiments have been performed on a disc machine of the type shown in Fig. 1. It is found that over a range of values of $\theta$ (angle of stator centre-line with tangent defining the mean direction of the rotor under the stator) the appropriate equation for linear speed is $v_s=v_c \cos\theta$. In other words, the "conducting sheet" (the disc) has a component of speed in the direction of the field equal to the field velocity. As the stator is turned, the disc goes faster. What is actually determined is that time per revolution (the inverse of speed) is proportional to $r \cos\theta$. With the stator pointing to the centre of the disc, the speed would theoretically be infinite, but the torque, zero.

In addition to the driving force introduced by the motion of the copper disc under the poles in the direction of the field there is a component of motion at right angles. This produces the braking effect always present when copper travels in a magnetic field. Investigation shows that for a high speed range, the ratio of pole width (w) to pole pitch (p) must be relatively high.

In the model sketched, end effects are of course important, and they produce various distortions of the simple equation mentioned. The first machine made, moreover, used a plain copper disc, and its efficiency was only about 0·1%, most of the loss being in the stator copper. An improved disc machine was made with the following improvements.

(*a*) The rotor speed was increased by operating at 600 c/s.

(*b*) The airgap was reduced and the pole pitch increased.

* A Brushless Variable-Speed Induction Motor by Prof F. C. Williams, O.B.E., D.SC., D.PHIL., F.R.S., M.I.E.E., and E. R. Laithwaite, M.SC., GRADUATE I.E.E.

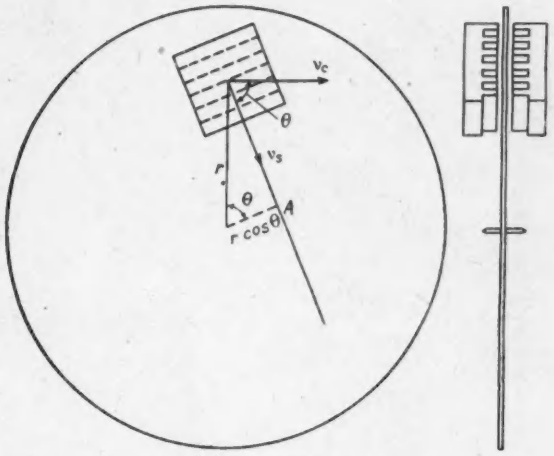



*Fig. 1. Diagram of experimental motor using copper disc; r is the distance from the disc centre to that of the stator*

(*c*) Iron was incorporated in the rotor by inserting iron rivets in the copper disc, afterwards machining both faces flat. In this connection it has to be noted that the stator has to conduct in all directions; a normal squirrel cage is useless.

The result was a machine with a ½ in. thick copper rotor of 6 in. radius, having 1,200 1/8 in. diameter rivets inserted. Stators 2·1 in. square with 10 poles carrying a four-pole winding were arranged with their centres at just less than 5 in. radius. The stators could be rotated as required. The performance results obtained are shown in Fig. 2. A speed range of over 2:1 was obtained, with $\cos\theta$ varying from 1 at the minimum to ¼ at the max. ($\theta$ from 0 to 76°).

A variety of experiments made with this machine suggest that a machine using the effect described can be produced,

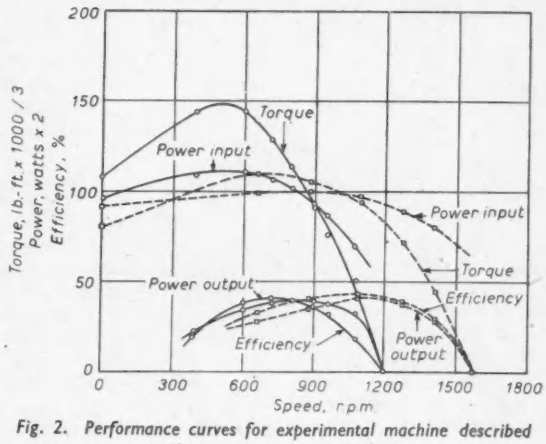



*Fig. 2. Performance curves for experimental machine described in the text operating at 600 c/s*

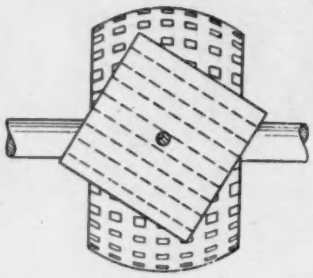


*Fig. 3.*
*Arrangement of rotor and stator in spherical machine. The rotor is a section of a sphere, and the stator face is hemispherical*

and that it seems to have all the properties of the normal squirrel-cage induction motor. Obviously, the disc machine has many disadvantages, particularly the change of surface speed with radius, which limits stator width and hence pole pitch, since w/p must be large. Some easing of this restriction may be obtained by changing from a disc construction to a barrel construction. This is of the type used in conventional machines except that, to allow rotation of the stator poles, it must be a spherical barrel, derived from a sphere. The inner pole surface is hemispherical. For a given rotor radius, a pole-width equal to the radius can be employed with only a 12% variation of surface speed under the pole. It is hoped that with such a construction, using a largely reactive rotor, a useful speed range of 3:1 can be obtained.

In the discussion at the I.E.E. meeting there was an understandably cautious approach to the idea of the motor as a practical machine. Indeed, the authors themselves emphasise that the paper is intended merely to give an early announcement of a new possibility. Perhaps the chances of practical application were best summarised by Mr G. B. Alvey (Mather and Platt). He emphasised that the trouble with most variable speed motors is their complicated construction and their lack of suitability for high speeds. If the moving pole machine could be developed in large sizes and for high speeds there would be a good future for it. However, he thought that at present it seemed essentially a low speed machine. At medium speeds it might have applications where motors had to operate in a foul chemical atmosphere. There would be competition with double-cage s.c. motors whose speed was varied by altering the applied voltage via an induction regulator. Such motors had an unstable speed/load characteristic, and the twisting pole motor might better this.

# Technological Education

THE case for the establishment of one or more "technological universities" and for the upgrading of selected technical colleges, was argued once more in Parliament last week, when Lord Glyn initiated a House of Lords debate on higher technological education. He drew attention to the recent report of the Parliamentary and Scientific Committee (see ELECTRICAL TIMES, 29th July, 1954) which made recommendations on some of these matters.

The principal Government speech was made by the Marquess of Salisbury, Lord President of the Council, who at the beginning of his statement emphasised that there is still a shortage of technologists. On the subject of the technological university, he said that many of our foremost scientists oppose the establishment of any such institution. He condemned it, despite its theoretical merits, as "not at present a practical possibility." In these circumstances, the right policy for developing technology in the foreseeable future was to concentrate on the building-up and development of certain existing university departments and technical colleges.

Reviewing existing plans at university level he referred to the proposed "massive expansion" of Imperial College, South Kensington, and for major developments at Glasgow, Manchester, Leeds and Birmingham. These were backed-up by less extensive schemes elsewhere. All in all, these schemes were expected to involve a capital expenditure of £15 millions or more during the next 10 years.

So far as technical colleges are concerned, the Lord President had no new proposals to offer, and he rejected suggestions that certain colleges should be taken from the control of local education authorities and given academic independance and a source of finance similar to the University Grants Committee. About 30 colleges had been planned for development ultimately into advanced regional colleges, but he felt it unrealistic to suggest that their lower grade activities in training technicians and craftsmen could be taken away easily and quickly. This was being done, but it would inevitably take a long time.

Supporters of the technological university who spoke in the debate included Lord Cherwell and Viscount Waverley. The latter did not believe that matters would be right until technology was recognised as being academically in no respect inferior to pure science and the arts. He felt that the setting up of large independent technological institutions should in no way prevent the full development of engineering faculties in the older universities, but he called for the new institutions to have the power to grant degrees. Lord Cherwell was more outspoken. He called for full scale technological universities, recognising that each one would cost about £1 million a year, and would need to be equipped on such a scale that it would not be justified were less than 3,000 students in attendance. Of the Universities, only London was large enough to absorb such an institution. He gave the Royal Technical College, Glasgow, as an example of an existing college which should be allowed and helped to expand in this way, independently of any university.

Amongst those opposing this idea was Viscount Falmouth, Chairman of Imperial College. He felt it would be a retrograde step to go forward with the idea of establishing a technological university. On the Continent and in America, he felt that the tendency was away from exclusively technological institutions. For instance, in the Massachusetts Institute of Technology and the Californian Institute of Technology it had been decided that students must spend one-sixth and one-fifth of their four years, respectively, in studying humanities or social subjects. With reference to technical colleges, he thought that where a course in a certain subject was of a particularly high standard, as might happen if there were large factories interested in that subject in the locality, then that particular course should be affiliated with the courses of a central college, so that the students concerned might proceed to a university degree.

The Earl of Halsbury, who is Managing Director of the National Research Development Corporation, said that there were about 200 engineers working on high speed digital calculating machines in this country. In the United States there were 1,700 in one firm alone, and that was only one of three big firms interested. He suggested that for the U.S. and G.B. statistical ratios were: population, 3:1; wealth, 10:1; university students, 30:1. That was why the Americans could flood engineers into a project.

# READERS' VIEWS

*Correspondents writing under a pseudonym are asked to submit their names in confidence to the Editor*

## *Fluid Filled 'Radiators'*

I HAVE read with considerable interest all the comments about my letter on the above units and would like to answer some points which have arisen.

To "Peregrin" (your issue of 11th November) I would state that having also tried and tested many forms of electric heating units I must agree on the small warm area around badly designed fires. At the same time, however, well-designed fires project their heat beams considerable distances. The following distances for body comfort conditions from appliance to body were measured on test: 9 ft for a 2,000 W fire and 13 ft from a 2,500 W model. This hardly necessitates the occupants huddling round the fire for comfort or for there to be a "myriad of fires about the place."

Mr A. C. Hazel's observations (25th November) of true comfort for domestic use have been proved over and over again. It is not generally known, however, that the radiant fire provides exactly these conditions with 30-40% of its heat emission as convection and 60-70% as radiation (figures for pencil-type elements). This amount of convection is usually sufficient for background heating in averaged-sized rooms and only large rooms may need additional air heating.

"Electro-Thermal" (2nd December) raises several points, but from his statement (60° F air temperature is necessary for radiant heating) he reveals that he is unaware of the basic principles and comfort conditions of this method of heating. If he had considered the warmth received from the sun amid the snows and low air temperatures of Switzerland he would have appreciated the folly of his remarks.

It was not my intention to advocate radiant heating for all space heating problems, there are applications for all methods, but in particular for living rooms of domestic dwellings.

In conclusion, the proof of the pudding is 3 years' entirely satisfactory radiant heating of living rooms with heat cheaper and more quickly produced than with fluid filled radiators.

*A. W. Bates.*
MANCHESTER.

## *Status and Salary*

IN your leading article "Status and Salary" you touch a very vital point—status.

When an engineer finds himself provided with a van inferior in every way to those supplied to meter readers, cooker repair men and other non-technical staff, I think you will agree that it is time that some "positive and recognisable advance in status" be made.

*"Van driver."*
SCOTLAND.

## *Isolator Overheating*

WHILST I agree that a main isolator should not be used as a make-shift coat hanger, I do not think that this could have been the cause of the overheating and subsequent breakdown to earth of the 30 amp isolation switch referred to by R. W. B.—"Problems and Practice," 9th December.

The design of this type of isolator is such that the contacts are closed and opened directly by the internal spring lever mechanism which in turn is actuated by the external arm. It is not possible to partially close or open the contacts by means of the external arm. This arm is moved in a downward or upward direction for approximately two-thirds of its travel without the electrical contacts being affected, then the spring lever mechanism takes charge and throws the moving contacts in or out of engagement with the tensioned fixed contacts.

This type of isolator, however, does require periodical maintenance, which, unfortunately, is overlooked in the majority of cases. When they are neglected, the contacts become oxidised thus increasing the resistance of their conductivity. This tends to set up arcing which causes overheating and loss of spring tension of the contacts aggravating the fault until more severe overheating eventually causes a complete breakdown of the isolator.

If the cover is completely removed from an isolator which has not been serviced for some considerable time, it will be observed on operation that the moving contacts do not go right home, they may in fact, only rest against their fixed counterparts. If now the moving contacts are cleaned and lightly smeared with vaseline and a generous dose of vaseline applied to the spring lever mechanism and rubbed well in, it will be found that after two or three operations of the arm, the switch will function as new.

This same trouble can also be found with rewirable fuse carriers, especially if the wall on which they are mounted is subject to vibration. The contacts should be cleaned and set at least once a year.

*J. E. Hooper.*
EWELL, SURREY.

## *Earth-Leakage Protection*

IT is only recently that Mr Swann's article on "Some Points about Electricity Regulations" has been brought to my notice, although it was published in your August issue.

I was most interested in what Mr Swann had to say and whole-heartedly support his comments in connection with planned maintenance and earth-leakage protection. I was, however, a little surprised that Mr Swann made no reference to e.l. tripping, his remarks implying that indication and recording are quite satisfactory.

Whilst I appreciate one cannot afford to trip out an essential service due to some minor earth fault on an auxiliary circuit, I do feel that in some cases where plant is operating in damp and steam-laden atmosphere, e.l. tripping should be given serious consideration as a more desirable protective measure than the use of indication and recording instruments.

In some instances it is not always possible to comply with British Standard Code of Practice for Electrical Installations as regards "a permanent and effective connection with earth." The resistance value between the earth electrode (or electrodes) and the general mass of earth should not at any time exceed 1 ohm.

With the above in mind I would suggest that providing the earth resistance value is of such a low order as to limit the greatest potential that can occur above earth to the Code of Practice's recommended value of 40 V, then e.l. recording and indication meet the requirements adequately. When it is impossible to get down to resistance values below 1 ohm, I suggest it is well worth while considering using e.l. tripping for leakage values that would result in the 40 V maximum being exceeded, combined with e.l. indication to give warning of the lower leakage

value. If proper attention is given to the fault in its early stages of development then the tripping device should never operate except for the purpose of testing. On the other hand prospective faults can be overlooked and earth faults of a high magnitude can occur without warning. Only tripping can provide the maximum protection to personnel in such cases, the damage very often being done by the time a person's attention is drawn to the warning device and the supply disconnected.

*T. B. Sansom.*
EDINBURGH 7.

### *Appointments from Outside*

WILL you allow me a little space to condemn the action of the London Electricity Board, who for the second time in succession have appointed their Secretary from the Local Authorities?

Why did they go outside the Industry again? What sort of future is there for the men in the Industry if London's lead is followed?

The London Board cannot expect us to believe that suitable men do not exist inside the industry—if they do, a glance at the ELECTRICAL TIMES Handbook will prove them wrong—and if experience counts for anything it should mean that a qualified man with experience of the industry is a better man than one with no experience of the industry at all.

Senior staff in the Supply Industry are rightly expected to display a high sense of loyalty and responsibility. Is it too much to expect the same of the employers in return? The London Board evidently think it is. No wonder there is such a widespread feeling that the industry has been let down.

*"J. T."*
LONDON, E.C.4.

### *Socket-Outlets in Hospitals*

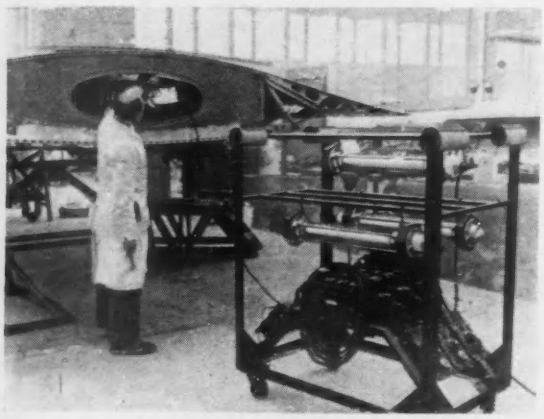
I WAS very surprised to read in your issue dated 2nd December, that "Megohm" advocates five-amp sockets and fifteen-amp sockets in hospital wards, and that the latter must be installed for portable X-ray or other medical apparatus. Surely the very extensive ranges of 13-amp sockets now available, would be preferable, and would give an installation of greater versatility, and at the same time of possibly less cost. I doubt if there are portable appliances which could not be adequately accommodated in 13-amp sockets. With the high diversity of load in a hospital ward, a ring-circuit serving each long side would minimise final sub-circuit fusing, and avoid two different sizes of plugs.

*W. Marsh.*
Electrical Engineer,
ILFORD BOROUGH COUNCIL.

## A FLAMEPROOF FLUORESCENT PORTABLE LAMP

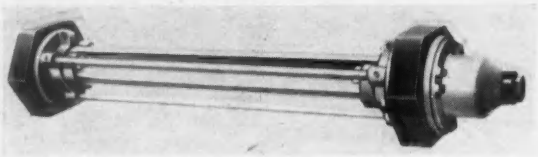
UNTIL recently the only form of portable fitting available for use in areas where Groups II and III gases are present, has been the incandescent lamp in a suitable enclosure. This form of lighting has obvious disadvantages, particularly when used in confined spaces as the high brightness of the light source can produce disability glare, and the heat output of the lamp can become uncomfortable to the user.

It is thus only natural that attention should be paid to the fluorescent lamp with its low surface brightness and cool operation, and to utilise this light source a fitting has been devised by the British Thomson-Houston Co., Ltd. This was made specifically to the requirements of British European Airways for servicing duties particularly within compartments of aircraft. This is illustrated below where a special rig is shown which includes the stand for the lamps together with control gear and leads.



*Portable lamps and control gear in use in British European Airways' maintenance hangar for inspection of wing compartments*

The fitting consists of two cast aluminium end boxes containing lampholders and starter socket, and three aluminium alloy spacing tubes are used to connect these end boxes together. A 40 W 2 ft lamp is contained between the end boxes and is surrounded by an armoured glass cylinder, and the ends of the fitting are protected by hexagonal rubber end shields. An adjustable reflector clips on to the glass cylinder and the fitting is suspended by three lugs so positioned that it can be slung vertically or horizontally. With a weight of 15 lb, the overall dimensions of the unit are, length 35¾ in., width 7 in., and depth, across the end boxes, 6⅛ in.



*Closer view of fitting to show constructional details*

One end box of the fitting has a cable entry suitable for use with v.i.r. insulated, overlaid tinned copper braid and polychloroprene sheathed 250 CMA grade, 5 amp cable, but the entry is adaptable to other types of cables depending upon application and local requirements.

To reduce the weight to reasonable proportions, the control gear is housed in a remote flameproof box which also contains a stepdown transformer to provide 110 V supply for the lamp.

Although designed for a specific application, the fitting and control gear can of course be utilised widely in places such as refineries, chemical plants, garages and so forth. At the moment, while complying with BS 229, the fitting is not Buxton certified. It is, however, being submitted for full Buxton approval and certification, but until this is finalised, the fitting can only be used where approval is granted by the local factory inspector.

# notes on wiring

by Megohm

A HOUSEWIFE was electrocuted, while using a hair-dryer, by touching a wire spiral spring, which was used to protect the cable and which had become "alive" The coroner at the inquest commented that it would be wise if all people having electrical apparatus in their homes were to have it examined *periodically by experts.* Very wise words indeed but something not often put into practice by the people concerned. Householders are not over keen to have their apparatus inspected because of the high costs involved. We in the electrical industry realise the many dangers which exist in faulty flexible cords, broken plug-tops and, of course, faulty wiring.

## *Examination of Apparatus*

In these days I doubt if there are many homes without some electrical appliance in use. Except, of course, those homes which are not wired for electricity. Irons, fires, toasters, hairdryers and standard lamps require flexible leads and these leads come in for some hard wear and tear. The flexible cords on standard lamps are very often trodden on and are subject to the attentions of domestic pets. Flexible cords should be frequently inspected for wear and should be replaced when damaged and *not* patched, as is often the case.

It is up to those in the electrical industry to encourage the householder in every possible way to keep his electrical apparatus in first class condition. This can best be done by those in the contracting trade and those responsible for the sale of electrical appliances. It would, however, be a difficult matter to arrange a regular "inspection and repair" service. The rather high cost of wages in the industry acts as a deterrent to the interested householder. He would be charged the cost of the operative's wage plus the contractor's profit, plus H.W.P. expenses. This adds up to quite a sum per man per hour. There is also the cost of material to think of and the possibility of further cost in time due to the operative not having with him the exact material required. All of which might add up to a fair sum of money. It is, I find, extremely difficult to persuade a householder that the money is indeed well spent. I do not intend, as is often done, to compare the cost of this service with the cost of the number of cigarettes one smokes in a certain time!

## *A Job for the Boards*

Perhaps I am on rather thin ice in making my next observation, but I make it in the hope that a solution can be found to this problem. I wonder if an "inspection and repair" service could be arranged by the Electricity Authorities. If a small amount was added to the householder's quarterly electricity account, and the total of the amount per annum was sufficient to cover say two hours of work by an operative, I feel that this would greatly assist matters. Any material used could be charged separately. The householder would not, I think, notice the extra amount on his account in the same way as he might do when handed a full account following such an inspection. The service could include one insulation test of the installation per year, and the results would be forwarded to the householder for his information and necessary action.

I trust that my contractor friends do not go up in the air at this suggestion of mine, but I do feel that the electricity boards have better facilities for providing such a service. I must point out that it is a matter of urgency for the average householder to be approached on this matter. Too many accidents and fires are caused by faulty apparatus and the problem must be tackled immediately. Any suggestions would be welcomed by the industry in general. Housing authorities could also assist by arranging inspections, paid for by the tenant through a slight increase in the rent. I appreciate that rents are high enough now but again, the *small* additional charge paid weekly, or monthly with the rent would, I feel sure, lower the number of accidents and fires, which although already relatively small in numbers might so easily be fewer still.

## *Hospital Installations*

In my Notes which dealt with the lighting in hospital wards I stated that a bed bracket should be installed for each bed. This is normal practice but apparently I overlooked one problem which often crops up. Let me say immediately that this was probably due to the fact that I have spent very little time as a patient in a hospital. The problem was put to me by a friend who, unfortunately, had spent some time in hospital. He pointed out that in these days of shortage of nursing staff and/or overcrowding it was often necessary to place extra beds in wards. This means that one lighting bracket is often shared by three patients. It is easy to visualise the complications which arise in such circumstances. It is also easy to appreciate the difficulty of allowing, in the original installation, for such situations and one can also imagine the possible "temporary" arrangements which might result from enforced improvisation.

However, after a little time spent in looking through catalogues, I found what I consider is the answer to the problem. This is a bedhead fitting which is clamped to the upright rail of a hospital bed. It is of all metal heavy gauge tubular construction in two sections, comprising an upright and an arm with a ball and socket joint. Another ball and socket joint is incorporated near the shade and gives a variety of positions to suit the user. The flexible is brought out at the bottom of the upright arm and connection can be made to the nearest lighting socket. A suitable switch can be incorporated in the flexible.

The fitting, complete with clamps, shade, holder and wired ready for use, costs 140s. list price. A very useful fitting indeed, not only for hospital use, but for many other situations where close lighting is required on a portable bench, etc.

# *Europe's Largest Arc Furnace*

## 60 TON INSTALLATION WILL CONSUME 1 MILLION UNITS EVERY WEEK

ELECTRIC furnaces have for long been used in melting steels to produce special alloy steels, but the installation of a new 60-ton arc unit by Samuel Fox and Co., Ltd., of Sheffield, is a new departure in size for this country, and the furnace is claimed to be the largest in Europe. It was formally commissioned recently by Mr G. Steel, managing director of United Steel Companies Ltd. When it is in full operation, it is expected to produce over 1,000 ingot-tons of steel a week, and to have a weekly electricity consumption of about one million units. It is expected that the furnace will be used mainly for the production of types of steel having a relatively low alloy content, most of which will find its way as semi-finished steel to the re-rolling, drop stamping and tube-making industries.

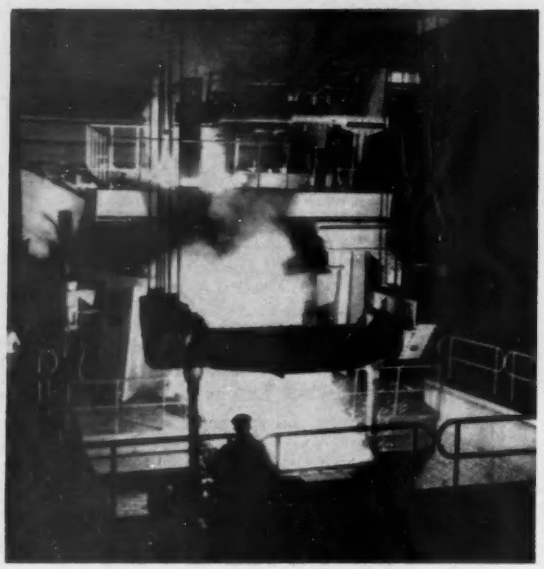
In the main, this description is concerned with the electricity supply and control installation, but before these are dealt with, the furnace itself deserves attention. Built by Birlec Ltd. in conjunction with Samuel Fox Ltd., it is based on an American design. It is a top-charged direct arc tilting type with three automatically-adjusted vertical carbon electrodes, each 20 in. diameter. The furnace shell is 19 ft inside diameter, backed with an 18 in. thick refractory lining, the bottom refractory lining being 27 in. thick and the roof 14 in. thick. Charging is carried out by lifting the roof on a robust hydraulic ram and swinging it clear to give access to the charging bucket. An hydraulic system is also used for tilting the furnace, the extreme inclinations possible being 45° forward and 15° backward.

Electrodes are controlled by a B.T.H. installation described later. The electrodes, in 6 ft sections, are held in clamps made from high-conductivity water-cooled copper castings, slipping and tightening being achieved by pneumatic and spring mechanisms respectively.

Provision has been made to incorporate electro-magnetic means of stirring the bath of metal, and appropriate equipment is to be fitted to the furnace next year.

Power for the furnace is supplied by the Yorkshire Electricity Board which has a ring main at 11 kV feeding a substation at the melting shop. Thence, the supply is distributed through a six-panel metal-clad English Electric switchboard comprising an incoming single-busbar c.b., four duplicate-busbar units with oil-immersed selector switches for distribution, and a single-busbar unit for the arc furnace supply. The breakers are of the horizontal draw-out type, and they have double-break contacts with de-ion grid arc control devices.

For metering and protection in connection with the arc melting furnace, six 1,000/5 amp current transformers are located in a separate oil-filled chamber on the fixed



*Pouring in process from the furnace*

portion of the arc furnace c.b. unit. A v.t. is provided in another tank.

The furnace transformer is also by English Electric. It is claimed to be the first of this type provided with on-load voltage control. Rated maximum output is 15 MVA for 11 kV, with the secondary voltage variable between 325 and 90 V using a motor-operated tap-changer. Control is via a multi-point selector switch mounted on the furnace operator's control panel. The transformer is arranged as two units housed in a common tank, the main transformer and a tapped regulating unit. A large number of disc coils in parallel make up the secondary, which is designed for an output current of 29,000 amps. The coils are paralleled on rectangular-section copper bars which pass up through the oil conservator to form the output terminals.

The regulating unit is a delta/star-connected double-wound transformer connected to the primary windings of the furnace transformer via the on-load tap-changer. Because of the wide voltage range covered, the secondary windings of the regulating unit are arranged as multi-layer coils, each layer forming one tapping step. On-load tap-changing by the reactance-bridging method is used, the necessary mid-point auto-transformer being located in a pocket on the tank side. The tap-changer itself is mounted on the floor of the pocket. Because of the onerous duty imposed on the divertor contacts, they are provided with special alloy contact tips, and the contactors concerned are housed in separate oil-filled drop-down tanks for ease of maintenance.

Cooling arrangements for the transformer consist of two 100% capacity oil/water heat exchangers, each with its own pump.

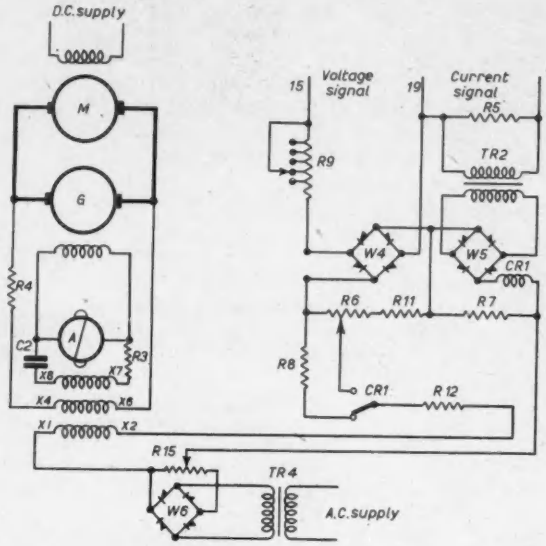
### *Electrode Control*

Each 20 in. diameter electrode weighs 20,000 lb when the supporting arm is included. Supporting the electrodes is an electrically driven winch. The wire cable which raises and lowers the electrode is passed over pulleys arranged to give a mechanical advantage of 4:1, and then wound round the winch drum which is coupled to a 725 h.p. motor through a 198:1 double worm reduction gearbox.

It is usual to control the power input to an arc furnace by maintaining constant are-impedance. To this end, the position of the electrodes is constantly adjusted. In the

B.T.H. control gear for the 60 ton furnace this principle has been used, and the winch motor moves in response to arc voltage and current, the electrode following the metal as it melts. In addition to the automatic control, hand control is provided.

When automatic control is in operation, the electrode speed is nominally 6 ft/min; in practice it is proportional to the distance the electrode has to travel to obtain the desired arc impedance once the arc has struck. This




*Schematic circuit of electrode control system*

minimises the effects of inertia. During the period before the arc has struck, the downward speed is limited to an arbitrary value selected to lessen the risk of electrode breakage. On hand control, speeds for raising and lowering are initially set at 6 ft/min and 4 ft/min respectively. An additional master control is set to raise the three electrodes simultaneously at 12 ft/min and lower them 6 ft/min.

The electrodes are not counterbalanced and compensation for them is provided electrically, in such a way that the winch motors themselves exert a constant lifting force on the electrodes, this constant force being superimposed on the automatic signal at all times so that there is no tendency for an electrode to run down and dip in the bath. Such an occurrence could be disastrous when low carbon steels are being made.

## *Control Circuit Details*

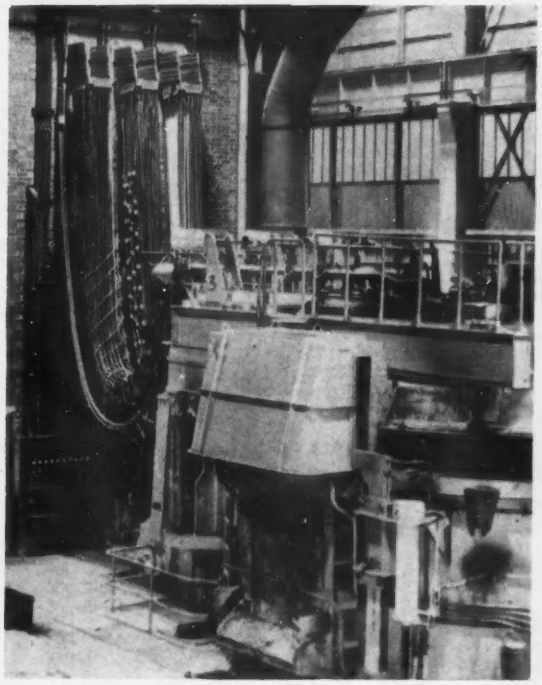
Mill type motors of 15 h.p., 725 r.p.m. rating are provided for the winches. They are vertically mounted on the side of the furnace. Each winch motor is supplied by a motor-generator set which is made up of a 13 kW generator, an amplidyne and a 25 h.p. driving motor. The generator is specially designed for commutating high peak currents, and its field is so arranged that it can be forced by the amplidyne. One spare m.g. set is provided. It is the size of the equipment which makes desirable the departure from the usual arrangement with the amplidyne directly supplying the motor: in fact, it works on the generator field.

Control circuits are mounted on a detachable self-contained panel which is mounted in turn in the main furnace control cubicle. Thus any electrode panel may be removed for servicing and replaced with a spare panel with little loss of time.

In each electrode control panel there are circuits for comparing arc voltage and arc current. With reference to the accompanying circuit-diagram, the arc voltage is applied across points 15 to 19 through resistor $R_9$ (this compensates for tap changing) to rectifier $W_4$. In the result, a d.c. voltage proportional to the arc voltage appears across resistors $R_6$ and $R_{11}$. In a similar way, a measure of the arc current, obtained via a current transformer, is applied to the saturating-core c.t. TR2 (this automatically limits the effect of current peaks) and after rectification by $W_5$ it produces a corresponding d.c. voltage across $R_7$. In this way, two d.c. voltages are available for comparison. The difference between them is fed to the control field of the amplidyne.

This is only the basic principle of the control circuit. Before the arc has struck, the movement of the electrodes is relatively slow, as already mentioned. Relay $CR_1$ controls this feature, changing over according to the presence, or otherwise of current flow in the electrode. The pre-strike speed is adjusted by $R_8$. $R_8$, mounted on the operator's control panel permits adjustment of the electrode current without tap-changing on the c.t. Amplidyne field X4—X6 together with $R_4$ provides field-forcing and reduction of residual voltage, and the circuit made up by $C_2$, $R_3$ and amplidyne field X7—X8 prevents hunting. Compensation for electrode weight, mentioned above, is provided by a bias circuit for which a separate source of voltage is provided via transformer $TR_4$ and rectifier $W_8$. A proportion of the resultant current is injected in the circuit of the amplidyne control field so that the generator circulates sufficient current to produce a torque on the winch motor and support the weight of the electrode.

The operator's control desk is located in a small room near the furnace. Individual electrode controls are provided, together with a group control switch for hand control of the electrodes, and a "hand-auto" selector.



*General view of the furnace, with leads to electrodes prominent in the background. The control room is just out of the picture, bottom left*

# Preventive Maintenance for Lighting

## COST ANALYSIS USED AS A BASIS FOR LAMP REPLACEMENT AND CLEANING FITTINGS

HOW often should works' lighting fittings be cleaned and lamps replaced? Usually, such tasks—the main sections of lighting installation maintenance—are only carried out when the appearance of the installation demands it but it was the aim of W. Robinson, B.SC., A.M.I.E.E., F.I.E.S., and J. W. Strange, PH.D., A.R.C.S., in a paper presented on Tuesday to the Illuminating Engineering Society, to show that in a large section of industry such haphazard methods may profitably be replaced by a system of preventive maintenance based on cost analysis.

Such systems may be applied in three main fields—to the large installation, where size alone merits its use; to the installation in which separate units are scattered widely over a large area creating a "horizontal inaccessibility"; and to the installation where, correspondingly, "vertical inaccessibility" of fittings requires careful planning to minimise costs. In these installations, a realistic view must be taken of the cost of carrying out any operation on the fittings, and although the value of planned cleaning and ordered lamp replacement becomes immediately apparent, the engineer is then faced with the difficulty of assessing the suitable times at which they may be effected.

### *Lamp Replacement*

In the types of installation considered, the basic cost of any servicing operation is such that lamp replacement is no longer merely a question of replacing lamps which have burnt out. At some time in the life of the lamp, its value, based upon its expected life, or residual value, has fallen so low that it is more advantageous to replace a group of lamps, at a lower labour cost per lamp, than to continue burning them to the end of their lives and then replace them individually. If the difference in cost between group replacement and individual replacement is greater than the lamps' residual value, group replacement may then be justified on a cost basis. Although the difference between individual and group replacement will vary from installation to installation, in the three fields under consideration, the labour cost of individual replacement may be as high as three to four times that of group replacement cost.

To determine the residual value, it is essential to have full information of the life characteristics of a given group of lamps. Such data are conveniently shown as a survivor curve, in which the number of survivors is shown against length of life. For the convenience of both user and manufacturer, however, it is desirable to replace lamps when observation of a batch as a whole indicates that their average length of life is approaching. In practice, this may mean when 20%, say, of the lamps have failed, and to determine the point accurately necessitates the construction of a residual monetary value curve, obtained from the survivor curve and the initial lamp value. It also requires an estimate of the actual hours of life. If only the manufacturer's claimed figure of average life is used, and this is a conservative estimate the benefit from the increase in lamp quality will not be fully obtained.

Such a curve shows, however, that for hot cathode fluorescent lamps, for example, the residual value at the point where failures start to occur with some frequency is already so low that only a small difference between individual and group replacement costs would show an advantage. At 80% of the average life of a typical batch, when some 20% of the lamps will have failed, the residual value is only about 22% of the initial lamp value.

From information of this kind, it is then possible to replace lamps either after a given time of operation, or after a given percentage failure. In the former case, lamp replacement may then be combined with normal cleaning of fittings. All lamps would be replaced, including "good" ones. The other procedure may only be operated where it is possible to assess reasonably accurately at what point lamp failures are likely to occur with increasing rapidity, but it has the advantage of utilising fully improvements in lamp performance.

### *Maintenance of Fittings*

When consideration is given to cleaning lighting fittings, it has first to be borne in mind that the rate of depreciation of the fitting varies throughout the period between successive cleanings. The light output from a typical reflector falls rapidly during the early months, then assuming the expected assymptotic form. The rapid initial rate of depreciation from the clean state is probably connected with the destruction of the specular componept of reflection. This loss of specularity may, in certain fittings, also affect the light distribution.

Location will, of course, affect the depreciation characteristics of a given fitting, although the range between best and worse reduces considerably at the end of long intervals between cleaning. Ventilation has a markedly beneficial effect on light maintenance. The benefit, moreover, extends equally to fittings relatively cool in operation (such as fluorescent) and to fittings comparatively hot, indicating that self cleaning operates by the dust being carried by the convection air out through the ventilating apertures, rather than the air current being sufficiently powerful to dislodge dust from the reflector. There is also indication that the effect takes place largely independent of the lamp being lit.

Cover glasses effect the maintenance requirements depending on the type of glass and its method of fixing. A series of tests has shown that it is essential they be fitted with gaskets, and even gasketed cover glasses may be useless, from the maintenance viewpoint; unless they are adequately sealed. Cover glasses may be desirable for other reasons, and may be left unsealed for either convenience or cost, and here it is probably a simple matter to wipe them frequently. In high bays or inaccessible positions, however, the matter is more serious and whereas open fittings will always provide a direct component of light, the addition of cover glasses which are not properly sealed may result in the loss even of this. Requirements for

adequate sealing are more stringent than is often realised, due to the expulsion of hot air from the interior, and the entry of cool air, with its suspended dirt, on cooling.

When designing a lighting installation, it is customary to employ an arbitrary maintenance factor, usually 0·8, and the average light output of lamps throughout life. Where casual lamp replacement obtains, this latter convention usually operates reasonably well but the adoption of group replacement would be bound to affect the result, and here a case can be made out including in the maintenance factor a provision for the fall off in illumination as the lamps age. It also appears that, for fairly clean locations, the maintenance factor of 0·8 provides a reasonable allowance. In dirty locations, however, the maintenance factor is closely linked with the cost of cleaning the fittings, the maximum variation in illumination which can be tolerated and the depreciation characteristics of the reflectors employed.

In a particular case quoted, were unventilated open fittings to be specified and a maintenance factor of 0·8 adopted, the designed service value could only have been maintained by cleaning reflectors once monthly. Adopting an m.f. of 0·6 or 0·7 would be a more realistic course, but open to the objection that the capital and running costs of the installation would be increased. In this case, only by using ventilated open fittings could an m.f. of 0·8 been realistic, with provision for annual cleaning.

Whether, from the psychological viewpoint, the term maintenance factor is more suitable than depreciation factor is debatable, although the latter term, which is a multiplying factor, gives a truer picture of the cost of depreciation than the former, which is a dividing factor. The term, however, conveys the idea of increasing the cost of useful light, by at least 50% in some installations visited. Instances of systematic maintenance were few and it seems therefore, wise to accept this situation, concede that the lighting industry will best serve the aims of its clients by examining the claims of both initial efficiency and of light maintenance characteristics of fittings to determine whether the best balance between the two is being obtained.

The standard dispersive reflector provides a good example for this argument, as it has combining lamp and fitting, a relatively high initial efficiency of 70%, with a possible minimum, after depreciation, of 40%. The reflector alone, therefore, contributes initially some 30% of the light output, most of which is due to specular reflection and is consequently lost in the early stages of depreciation. It might then be considered whether an open top, releasing up to 30% of the light output upwards, and improving the maintenance characteristic, would be a better proposition.

# *Electrical Interlinking for Differential Analyser*

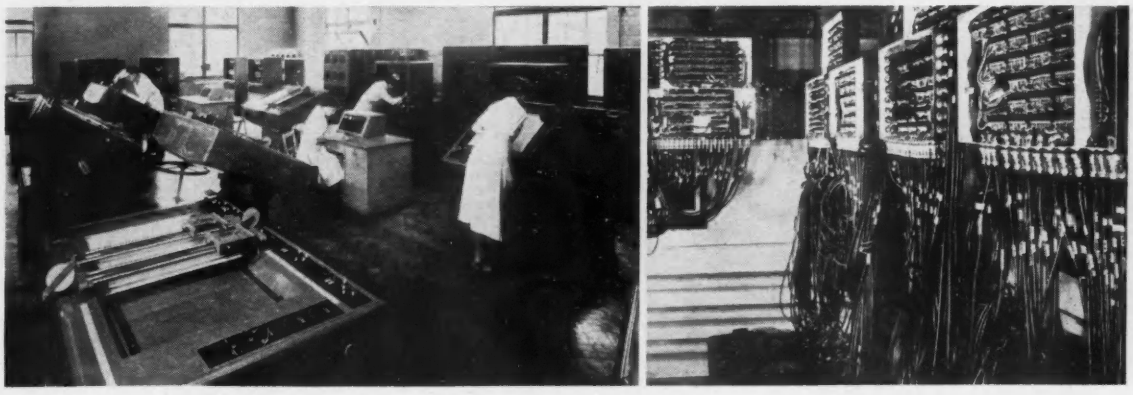
A NEW differential analyser—the largest in the world—is now in operation at the National Physical Laboratory. It has taken over five years to build and will be of invaluable assistance to physicists, mathematicians and engineers. The great advantage of the new differential analyser over earlier instruments lies in the use of electrical servo-mechanisms to link special mechanical devices which are used to perform mathematical processes. In this way, great versatility is achieved, as the mechanical units can be linked in any combination in a matter of seconds by means of a central plug board similar to the type used in telephone exchanges. In the older machines, where the appropriate units were coupled by means of mechanical linkages, several days were often spent in setting up the instrument to tackle a problem and engineers often had to resort to trial and error for a working solution to their problems. With the new machine results are given to an accuracy of three figures—quite sufficient for practical purposes.

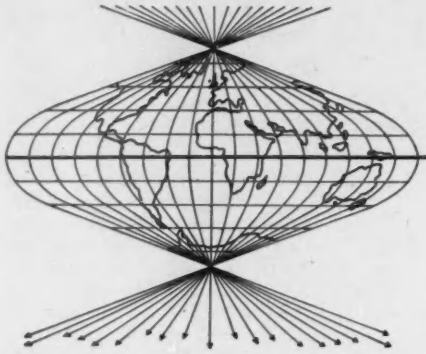
The prime function of the differential analyser is to solve differential equations, and it may be used to find the solution to any problem which can be expressed in this form, including many in diffusion and heat transfer, ballistics, electron optics, statistics, ultrasonics, aircraft design (which involves exceptionally complicated mathematics, especially in connection with supersonic flight), mechanical analysis, and a wide range of applications in electronics and atomic physics.

Wiring the servo-mechanisms to the central plug board presented a major problem. For this, the experience of The Plessey Company Limited in the development of preformed wiring systems for aircraft was called upon, and special cable forms and wiring accessories were made by this company. There were no less than 35,000 separate connections, the circuits being coupled with over 1,700 multi-way plugs and sockets through 73 giant junction boxes using 18,000 ft of multi-core cable.

This electrical installation has proved entirely satisfactory in use and has helped to bring a rapid and comprehensive new service to the aid of British scientists and engineers.

*Left is a general view of the Differential Analyser, and on the right is part of the electrical connection system*





# OVERSEAS NEWS

### A SUMMARY OF IMPORTANT EVENTS

## CANADA

### Bulk Supply Wanted

With its present bulk supply contract with the Gatineau Power Co., due to expire at the end of 1955, after which the company will be unable to continue the supply, the Dalhousie Town Council has been seeking another source of electricity supply. Its approach to the New Brunswick Electric Power Commission for a supply has been rejected by the latter who states that they are unwilling to sell power in bulk for distribution in Dalhousie. The Commission has also made a survey of the local distribution system and submitted an offer for its purchase, although the actual figure has not been released. The whole matter is still under consideration by the Council.

### New Brunswick's Bright Outlook

An increase of 10% in power generated and purchased during the year ended 31 Mar. last, was achieved by the New Brunswick Electric Power Commission, according to the annual report covering that period. Faced with the prospect of abnormal demands for power from the mining industry, the Commission has already started on implementing the Beechwood hydro-electric development—a run of the river plant—which initially will have two 45,000 h.p. units, with a third set to follow as required. The Commission is also to install an additional 29,500 h.p. of plant at the Chatham steam station. During the year covered by the report, the Commission's power plant generated 357·6 million units, of which 76·8 million was produced by the new 27,000 h.p. Tobique hydro development during the first eleven months it was in operation. Already over 90% of New Brunswick's homes have electricity — 3,127 new domestic consumers were added during the year, bringing that total to 64,181. Looking ahead, the System Planning Section of the Engineering Department has been studying matters relating to further 138 kV transmission line, and planning additional substations and 69 kV transmission lines.

### Quebec's Outlook

A promise that the Bersimis No. 1 hydro-electric project would be supplying power to Montreal before Christmas 1956 was given by Mr R. Dupuis, a commissioner of the Quebec Hydro Commission, in a recent talk to the Electrical Club of Montreal. He also explained that preference was given to the Bersimis scheme in 1952 over other projects in the vicinity, because with the growth of demand all power obtained from Bersimis No. 1 would be taken up before a single kilowatt could be generated at Lachine. Bersimis No. 1 would have an installed capacity of 1,200,000 h.p. Mr Dupuis said a decision on the further development of Bersimis would have to be reached soon because the demand for power was not slacking. Bersimis No. 2 might very well be the next big undertaking, he added. Site No. 2 of the Bersimis project was 18 miles below site No. 1. Regulation of the river had been made, roads were practically ready and a complete, efficient organisation was ready to complete the development when necessary. In connection with the Seaway scheme, Mr Dupuis disclosed that the Commission was considering a two-stage development: one big power house at Heron Island and a smaller one below Laprairie basin. He observed that it was a plan that would be "tied very loosely with navigation." The construction of two power houses, it was held, would be more economical than having long, high dykes with their inconveniences.

## SWEDEN

### H.E. Scheme

Plans are being prepared for the construction of a new power station on the Kultsjoe river, a tributary of the Aangermanland river in northern Sweden, we learn. The new power station will be called Stalon, and will have an average annual production of 700 million kWh. It will cost 120 million crowns to build and should be finished by 1962.

## EUROPE

### Italy's Outlook

According to a recent report prepared by a special Italian Ministerial Committee on the problems of the country's electricity industry, it is estimated that Italy's power requirements will increase to about 50 milliard kWh p.a. by 1960. This increasing demand will necessitate a corresponding expansion of Italy's productive and distributive facilities. Total investments needed for this purpose are estimated at 1,783 milliard lire, of which 806 milliard lire will be spent on the construction of new power plants and 977 milliard lire for HT and auxiliary transmission. The financing of this major scheme will be carried out partly from domestic sources and partly by obtaining private loans abroad. In order to attract foreign investors, the Committee expressed the opinion that the individual enterprises involved should be made to pay their way and that the equalisation fund for electricity tariffs should either be completely abolished or made to serve other purposes. Furthermore, the conclusion of separate arrangements with consumers is advocated, with the exception of those sectors in which a general unification of tariffs is envisaged.

### Another Station

Plans for a new steam power station at San Adrian, Barcelona, with a capacity of 130 MW, have just been announced. Intended to start operation in 1957 and reach completion the following year, it will produce 600 million kWh annually. The first equipment to start operation will be two sets of 35,000 kW each, to be followed by a third unit of 60,000 kW. All three will be capable of burning either fuel oil or coal.

## S.W. ASIA

### A New Bill

The Kashmir Assembly has referred to a select committee a Bill to amend the State Electricity Act. The Bill, introduced by Mr D. P. Dhar, Deputy Home Minister, seeks to provide a statutory basis for the Government to undertake the supply of electric energy and to authorise the Government to recover electricity charges in a summary manner as in the case of land revenue arrears.

### Warsak to Progress

The Pakistan government has now signed an agreement with Canada under which the latter will provide assistance for the implementation of the Warsak multi-purpose project. The Canadian government have already allocated nearly $9 millions for the Warsak project since 1952. The Canadian aid will take the form of equipment and technical services, and H. G. Acres and Co., the Canadian firm of consulting engineers, are to draw up detailed plans and supervise construction. That firm has already done

preliminary work on the project. The Central Engineering Authority will be in charge of the project on behalf of the Government of Pakistan. Located on the river Kabul at Warsak, 19 miles north-west of Peshawar, the Warsak project comprises, apart from other appurtenant works, a rock-fill dam 235 ft high, an underground power station with an installed generating capacity of 150,000 kW, an irrigation tunnel of about 300 cusecs to feed a high level canal commanding 93,000 acres of fertile land, west of Peshawar, and power transmission lines connecting Warsak with the Punjab. The reservoir created by the dam would enable navigation from Warsak to the Afghan border. The project is expected to be completed within a period of 4 years at a total estimated cost of Rs. 220 millions.

### Punjab's Need

The need for stepping up the production of electricity in the country and its supply at cheap rates to industrialists was stressed by the Punjab Chief Minister when inaugurating the Pakistan Industries Fair at Lahore recently. Referring to the electricity schemes of the Punjab Government, the Chief Minister disclosed that three hydro-electric schemes were on the anvil and through technical and financial assistance of the Commonwealth countries these schemes would be implemented. In Muzaffargarh, he said, in about a year and a half nearly 75,000 to 100,000 kW of electricity would be produced to cater for the developing industries. The aim of his Government was to supply electric power at reasonably cheap rates. With this policy in view, the Punjab Ministry had introduced uniform rates of electricity throughout the province.

## THAILAND

### Decision on H.E. Scheme

The plan to build a hydro-electric station in connection with the Chainat irrigation dam, Thailand, has been discarded by the National Energy Council. Apparently it is now considered that the earlier decision to construct the Yankee hydro-electric station obviates the need for a power station at Chainat, at least for the present time.

## AUSTRALIA

### Local Order

One of the biggest alternators manufactured in Australia is to be made by Northern Electric Pty. Ltd., of Rocklea, Brisbane, for the Cunnamulla powerhouse. It is a 456 kVA machine attached to a 640 h.p. diesel engine. The tender for this alternator and engine by Ruston Hornsby (Aust.) Pty. Ltd., has been accepted by the State Electricity Commission of Queensland.

### Domestic Consumption

The average South Australian domestic consumer is now using nearly four times as much electricity as in 1940, the chief engineer of the Electricity Trust, Mr K. H. Milne, stated recently. He said this huge growth in the demand for electricity meant that, at times, power mains in sections of the metropolitan area had to be replaced by heavier mains. Mr Milne was explaining the reason for temporarily cutting off supplies to certain districts to enable the reinforcement work to be carried out. Mr Milne said that in 1940 the average domestic consumer used 490 kWh per annum. By 1950 the usage had increased to 1,170 kWh, and in 1954 it had jumped to nearly 1,800 kWh.

## NEW ZEALAND

### Power and Water Supply?

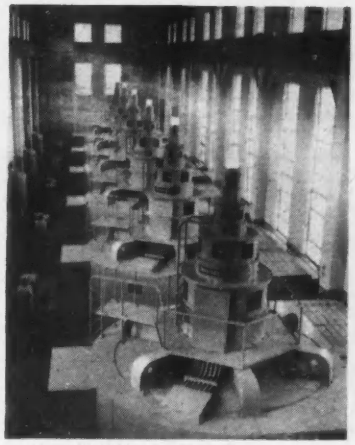
A proposal for the establishment of a metropolitan authority for Auckland, New Zealand, to control the functions of territorial and special-purpose local bodies, has been opposed by the Auckland Electric Power Board. According to Mr J. A. Steele, chairman of the Board, the latter considers that such an authority would be cumbersome and unwieldy. Prompt decisions would be difficult to obtain and various services would have to be controlled by committees acting under the jurisdiction of the central authority. Special services of a metropolitan nature could best be administered by special-purpose local authorities with jurisdiction over the whole metropolitan area. Three—transport, drainage and electricity—are already administered in this way, and the board feels this policy should be extended to water. Commenting on the latter suggestion, Mr C. J. Lovegrove, a former chairman of the Board, claimed that the Power Board had the organisation to do the job if a Greater Auckland water supplying authority was sought. Combined water and power boards were working overseas in the best interests of consumers. "The board lays power mains so why not water mains?" he asked. "We have power meter readers who could read water meters also. Above all," Mr Lovegrove said, "we have a vast organisation which could accept the responsibility of water distribution in its stride."

# British Columbia's Expansion

AN increase of 32% in energy generated and purchased during the year ended 31 Mar. last is the splendid record of the British Columbia Power Commission. Bulk industrial supplies totalling over 396 million units, were largely responsible for the increase, but consumption of the 44,321 residential consumers jumped by 18%, while commercial consumers took an additional 10%. Over 90% of the power was provided by the commission's own hydro-electric plants, about 7½% came from the many diesel stations serving small relatively-isolated districts, and a further 1½% was purchased from outside undertakings.

The average consumption of domestic consumers amounted to 2,448 units p.a. The Commission's generating capacity increased by 35% during the year, to a total of 174,255 kW, principally due to the completion of the third and final phase of the John Hart development at the Elk Falls site, which added 40,000 kW to the system capacity. A further 9,234 kW of diesel generating units were installed in ten districts. The development of two other hydro projects has been commenced—one on the Spillimacheen River (4,000 kW) and the other on the Puntledge River on Vancouver Island (25,000 kW). On the transmission side, ten miles of 132 kV line were erected, and work started on a 63 kV line from Whatshan to Nakusp.

Looking ahead, plans are in hand for a hydro-electric development at Ladore Falls at the outlet of Lower Campbell Lake on Vancouver Island, and a survey is also to be made for a proposed development at Helmcken Falls on the Martle River. A survey was also carried out at Tastsquan Creek near Bella Coola to determine the possibilities of construction of a small hydro development to supply the Bella Coola area. Reference is made in the report to the rehabilitation of the Whatshan power station which was partially destroyed by two mud slides in Aug. 1953. One unit has been returned to service and other work is continuing. To meet the cost of this work, the contingencies reserve has been increased to over $1,025,000 and a further appropriation will be made from the current year. The net operating surplus for the year covered by the report amounted to $531,167, which can be considered very satisfactory in view of the reductions in tariffs which have taken place. It should be explained that the Commission was only established in 1945, and operates in 27 widely-scattered districts throughout the province.



*The 120 MW John Hart Development*

# Personalities

## IN THE INDUSTRY

Chief engineer of the Penang (Malaya) Municipal Council's Electricity Department for many years, **Mr S. Mortimer,** A.M.I.E.E., ASSOC.I.MECH.E., retired at the end of November last.

District engineer at Runcorn for the Merseyside and North Wales Electricity Board for the past 5½ years, **Mr P. D. Smallman,** D.F.H., A.M.I.E.E.., has been appointed senior assistant engineer (operation) at the Board's No. 2 sub-area. Before going to Runcorn, Mr Smallman was with the Yorkshire Electric Power Co., at Hull. Trained at Faraday Hse, he started in the Industry with the Y.E.P. Co., and afterwards served with the Mersey Power Co., Kennedy and Donkin Ltd., and Scottish Cables Ltd., at Renfrew, before joining the Buckrose Light and Power Co., in 1946 as deputy engineer. He stayed at Driffield until 1948 when he became senior mains engineer, Hull District, No. 6 sub-area of the Yorkshire Electricity Board, holding that position till 1949.

**Mr C. A. F. Fuller-Shapcott,** sales director of Chilton Electric Products Ltd, left England last week in the *Queen Elizabeth* for New York where he hopes to sell the firm's electric dry shavers to American stores, electrical retailers, etc. He will be away for 2-3 weeks.

British Insulated Callender's Cables Ltd. announce the appointment of **Mr P. R. Dunn,** B.SC., M.I.E.E., as chief engineer, in succession to **Mr D. T. Hollingsworth** who has recently been appointed to the board of the company.

Educated at King Edward's School, Birmingham, Mr Dunn afterwards studied electrical engineering at Birmingham University, gaining the degrees of B.Sc., with first-class honours. In 1925, he joined British Insulated and Helsby Cables Ltd., as a construction engineer on the installation of mains cables and overhead equipment for railway electrification. This was followed by a period of investigation and development work on high voltage cables and on factory processes. In 1932 he was appointed sales engineer to the company's Manchester area and in 1939 became assistant to the chief engineer. After the formation of British Insulated Callender's Cables Ltd. in 1945 he was engaged largely in technical liaison matters until being appointed deputy chief engineer in 1952.

Mr Dunn is a past president of the North Western Branch of the Association of Mining Electrical and Mechanical Engineers and of the Manchester and District Branch of the Institute of Welding. He is the present chairman of the Mersey and North Wales Centre of the I.E.E.

**Señor V. E. Mollo,** an engineer from Argentina, recently joined the English Electric Co., Ltd., at Stafford for training under the Federation of British Industries' Overseas Scholarships scheme. Sr. Mollo has degrees in both electrical and mechanical engineering and has also studied civil engineering. He is employed by the Directorate of Electricity and Engineering at Buenos Aires as an estimator and designer and is here to widen his knowledge of the generation and distribution of electricity.

The Liverpool Electric Cable Co., Ltd., announce that **Mr E. A. Wilbraham,** their special colliery representative, is retiring at the end of this year and will be succeeded by **Mr J. Atherton.** Mr Atherton received his training at the Royal Technical College, Salford, and after serving an apprenticeship with Switchgear and Cowans Ltd. joined the Liverpool Electric Cable Co., Ltd., in 1934. He served as Head of the Test Department for several years, being transferred to the sales staff in 1945, and in 1949 was appointed branch manager at Nottingham.

*Mr P. R. Dunn*

*Mr J. Atherton*

*Mr Percy Evans*

**Viscount Chandos,** chairman of Associated Electrical Industries Ltd., was introduced in the House of Lords on Wednesday of last week.

Over 80 long-service employees at the Stafford works of the English Electric Co., Ltd., were last week presented with awards by the company. The presentations were made by **Mr E. B. Banks,** chief commercial manager, **Mr J. R. Sully,** general manager, Stafford, **Mr R. J. Saunders,** commercial manager, Stafford, **Mr A. Reader,** works manager, Stafford, and **Mr J. M. Ferguson,** chief engineer, Stafford. Before the awards, the long service employees, all with a minimum of 40 years' service and some with 52 years, were addressed by **Sir George H. Nelson,** chairman and managing director, who expressed appreciation of their loyalty.

*Sir George Nelson, right, congratulates a recipient who has just received his award from Mr A. Reader*

General sales manager of Hopkinson Electric Co., Ltd., **Mr Percy Evans,** A.M.I.E.E., has been appointed to the board of that company with the title of sales director.

After more than 48 years' service in the electrical industry, **Mr G. W. Hodsman** has retired. From 1920 until nationalisation in 1948, he was constructional engineer for Bradford Corporation Electricity Department. He was also organiser for the department's training scheme for young engineers. On his retirement he was presented with a cheque by his colleagues from Bradford and Leeds.

Appointed as engineer-in-charge of the B.B.C.'s new temporary television transmitting station at North Hessary Tor, South Devon, is **Mr C. R. Jephcott,**

A.M.I.E.E. Mr Jephcott joined the Corporation in 1935 at the Droitwich transmitting station at North Hessary Tor, as maintenance engineer in 1941. In 1946 he transferred in that capacity to the B.B.C.'s short-wave transmitting station at Skelton, in Cumberland, which post he has held until now.

**Mr Olav Fossen,** chief engineer, Electricity Board of Norway, recently visited the Witton Engineering Works of the General Electric Co., Ltd., to witness tests on a 62·5 MVA alternator which has been built there for the hydro-electric power station at Aura Kraftonlegg, Norway. He was accompanied by **Mr C. A. Christiansen,** proprietor of A/S Elektrosalg, the Norwegian agents of the company.

**Mr R. F. A. Baldwin,** general manager, Electrical Department, has been appointed to the board of directors of W. B. Dick and Co., Ltd.

**Mr J. J. Jordan,** manager of the Cardiff branch of Philips Electrical Ltd., has completed 25 years' service with the company, and to mark the occasion he was recently presented with an inscribed gold watch and a cheque by Mr G. Hofman, managing director.

A cheque for £400 has been sent to the British Empire Cancer Campaign Fund in memory of the late **Mr W. M. B. Furniss,** formerly managing director of the Electric Construction Co., Ltd. Mrs F. J. Furniss and her children and Mr W. M. Furniss and family have asked us to record their gratitude to all the kind friends who generously contributed to the cheque.

Recently home from a five-week business tour of the Middle East is **Mr R. K. Spencer,** assistant chief engineer of E. K. Cole Ltd.

**Mr James Ritchie** has been appointed financial director of the British Aluminium Co., Ltd., as from 1 Jan., 1955. He will relinquish his position as secretary and will be succeeded in that appointment by **Mr H. A. Woodroffe.**

**Prof F. Llewellyn Jones,** of the Department of Physics of the University College of Swansea, has returned to the College after a lecture tour in the United States lasting several weeks.

*Members of the C.E.E. visit E.D.A's Testing House*

Our accompanying photograph was taken at the 24th Annual Ball of the E.I.B.A. Northern Counties area, held last week at Newcastle-on-Tyne. **Mr J. C. Mitchell,** O.B.E., M.I.E.E., M.I.MECH.E., Divisional Controller, North Eastern Division, B.E.A., and chairman of the Northern Counties Area E.I.B.A. Committee, and his daughter-in-law, **Mrs J. W. W. Mitchell,** received 300 guests, and were supported by **Mr J. Gibson,** chairman-elect. Our photograph was taken when Mrs R. H. Davidson, wife of Mr R. H. Davidson, a member of the Committee, presented a bouquet to Mrs J. W. W. Mitchell. Also shown are Mr J. C. Mitchell, Mr J. W. W. Mitchell, Mr J. Gibson, Mr R. H. Davidson, and Mr A. Parkin, honorary organiser.

*At the North Eastern E.I.B.A. Ball*

**Bailie J. Sullivan,** of Glasgow, retired from part-time membership of the British Electricity Authority on 30 Nov., on being appointed a member of the new South of Scotland Electricity Board with effect from 1 Dec. last.

**Mr K. L. Harris** has been appointed representative for Cornwall, Devon and part of Somerset, for the Radio Sales Division of E. K. Cole Ltd. He succeeds **Mr G. R. Lawson-Thomas,** who, after many years with the company, is now entering the retail side of the trade. Mr Harris, who was formerly assistant to Mr R. S. Underwood, assistant sales manager, South, is already known to many Ekco dealers in the area he will be covering.

The International Commission on Rules for the Approval of Electrical Equipment (the C.E.E.) had a series of meetings at the British Standards Institution, London, W.1, last week, when the subjects under discussion were lighting fittings, portable tools, and fuses. On Wednesday of last week the members of the C.E.E. were entertained to luncheon at the Burford Bridge Hotel by the Electrical Development Association, and afterwards they visited the E.D.A. Testing House at Leatherhead. Our photograph shows a group of members interested in the motor test machine there. From left to right are **Mr H. Thesio** (France), **Prof de Zoeten** (Netherlands), **Mr R. Harvey** (Manager, E.D.A. Testing House), **Dr T. Dall** (Germany), **Prof C. Volpi** (Italy), and **Dr F. Lavster** (Germany).

## OBITUARY

**Mr E. T. Hippisley,** M.A., A.M.INST.C.E., M.I.E.E., M.I.MECH.E., manager of the Traction Department (Sales and Engineering) of the British Thomson - Houston Co., Ltd., died on 9 Dec., aged 61. Throughout his career, Mr Hippisley devoted himself to electric traction in which subject he was an acknowledged authority.

*Mr E. T. Hippisley*

After matriculating at St Peter's College, Westminster, Mr Hippisley entered Trinity, but his Honours Course in Engineering at Cambridge was interrupted by war, and it was not until June 1919 that he graduated with a B.A. Degree. In February, 1920, Mr Hippisley entered upon a three-year post-graduate apprenticeship with the British Thomson-Houston Co. He joined the staff of the Traction Department early in 1923, where for a time he specialised in the electrical design of traction motors, in pursuance of which he spent some months during 1928 in U.S.A. From 1929 onwards he was responsible for heavy-traction contracts involving electric and diesel-electric locomotives; and in June 1936 was appointed manager, Traction Department, a position he held until his death.

**Mr J. Dempsey,** A.M.I.E.E., A.M.I.MECH.E., M.INST.F., station superintendent at Exeter power station, South Western Division, B.E.A., died on 6 Dec.

**Mr J. T. Graham,** O.B.E., A.R.T.C., M.I.MECH.E., a part-time member of the East Midlands Electricity Board, and joint assistant manager of Worthington-Simpson Ltd., died on 4 Dec. Educated at Royal Technical College, Glasgow, he served an apprenticeship with William Beardmore and Co.

We deeply regret to learn of the death in South Africa on 13 Dec. of **Mr E. E. Sharp,** M.I.E.E. Mr Sharp went out to that country to take up residence in 1949, but has since visited Britain several times. He served the Electrical Industry nobly, commencing in 1891 in the

London office of Mather and Platt, and later going to the Chloride Electrical Storage Co., but it was mainly for his long association with Venner's that he became well known throughout the industry. He joined Venner's when the company was agent for other firms' meters, and was made manager in 1902. When the time switch section was converted into Venner Time Switches Ltd., in 1911, Mr Sharp became a director. He was also a director of the Jackson Electric Stove Co. from 1913 until 1922, and was one of the founders of Tok Switches Ltd. His other prominent association was with the E.I.B.A. and its forerunner, the E.T.B.I., having been chairman of the Executive Committee—The Court, as it was known on the change of title—and president of the Association in 1938.

**Mr E. P. Lucking,** M.I.E.E., manager of the London and district sales office of George Ellison Ltd., from 1914 until his retirement last Jan., died on 9 Dec. aged 64. He was also a director of Nathan and Allen Ltd. Prior to joining George Ellison Ltd. in 1912 he was with Adams Manfg. (now Igranic) and G.E.C.

**Mr R. H. M. Lea,** C.B.E., B.E., M.I.E.E., M.I.E.(AUST.) chief engineer and general manager of the Electricity Trust of South Australia since its formation in Jan. 1947, has died aged 56. Earlier he had been assistant manager of the Adelaide Electric Supply Co. for ten years.

# NEW LITERATURE

### *Modern Armature Construction Winding and Repair*

*by Stuart F. Philpott,* M.I.E.E.

THE armature of an electrical machine comprises the main cost and therefore it is understandable that the author has felt fit to write a whole book about the subject, firstly, from a production, and secondly, from a repair point of view. Winding techniques for new machines or repair are basically the same, but with the new machine, advantage can be taken of the latest methods which allow some degree of mass-production to be adopted, especially for the smaller sizes. Treatment is not quite as broad as the title would suggest, since only rotors up to 10 in. diameter are considered, however, these are dealt with in great detail.

The book is directed to production engineers and repair firms mainly, although it should also be of interest to maintenance engineers in particular and students. In view of this, the content is mainly practical; theoretical considerations being confined to the introductory chapter only and mathematical treatment is a minimum. In the second chapter the general methods of armature construction are dealt with and a description of some of the machinery employed for laminations, burr grinding and other operations is included. Illustrations liberally intersperse the text in sections dealing with armature winding; either direct on the rotor, or wound on a former. The various ways of connecting winding ends to the commutator are then described.

Faults expected and testing methods receive attention in the next chapter, drop testing, growler and other methods being described. Soldering, securing the windings and varnishing are each devoted space and the book winds up with chapters on balancing and armature repairs. Altogether a useful collection of material presented in a semi-technical manner, but with the sound experience of a practising engineer showing through, this book presents a balanced picture of contemporary methods of construction and repair. Published by Pitman, 280 pages, 7¼ in. by 4¾ in. Price 30s.

### *Mechanical World Year Book 1955*

THE main changes in the 1955 edition are a complete regrouping of the chapters dealing with materials, so that ferrous and non-ferrous metals and plastics are now dealt with together, following the section covering heat treatment, die casting and hardness testing. This regrouping was necessitated by the rapid strides being made in materials developments, and hence resulting in extensive modification of the relevant sections. A notable example of this development is seen in steels for gas turbines, where choice of the material depends on the complete understanding of its characteristics, particularly in its tendency to creep. Apart from this major change, other differences are seen in detailed revision in other sections to bring the text up to date. In subject matter, this useful compendium of information and data ranges from turbines, through gearing, to properties of materials, whilst practical engineers will find the 120 pages of tables at the end invaluable in assisting to find the right answer. On their own, they are worth the low price asked for the book Published by Emmott and Co., Ltd., 31 King St W, Manchester 3, 360 pages, 6½ in. by 4½ in. Price 3s. 6d.

### *Mechanical World Electrical Year Book 1955*

THIS year opportunity has been taken to completely revise the chapter on control gear and to add a new section on suppression of interference with radio reception, otherwise the book remains largely unaltered. With the increasing complexity of modern control gear it does well to take stock of all the various methods available. Circuit diagrams and explanations give details of the main types in use today for both a.c. and d.c. machines and the chapter winds up with some notes on braking.

Interference suppression is concerned with describing the main sources of the phenomena and ways of overcoming the troubles arising. Stress is laid on the point that care must be exercised to install any suppression apparatus in a manner which ensures the general safety. With its wide scope, the book remains, as ever, a fund of useful information and, for its size, goes into a surprising amount of detail. All the usual tables are provided, these are supplemented by a small section on basic trigonometry and vector algebra. Published by Emmott and Co., Ltd., 359 pages, 6½ in. by 4¼ in. Price 3s.

### *Low Frequency Amplification*

*by Dr N. A. J. Veorhoeve.*

IN a manner which can only be regarded as authoritative, the author has produced a volume which stands out in a field where so many books claim the engineer's attention. Yet, despite his technical mastery of the subject, the author has contrived to present it without the heavy mathematical clothing to be found in other volumes intended, as this, for the practical engineer. The range of subject matter is exhaustive, commencing from an introduction of both electrical and accoustical principles which manages admirably to combine brevity with effectiveness, and terminating in sound system measurements. Between these two extremes, the content discusses, with characteristic thoroughness, amplifier valves and circuitry, components, power units and values, input and reproducing sound sources, and amplifying and relaying sytems to provide a competent reference work. Published for Philips' Technical Library by Cleaver Hume, 495 pages, 9 in. by 6 in. Price 50s.

## BOOKS RECEIVED

**Building Technicians' Diary, 1955,** Technical Section covers all aspects of building, including a helpful electrical section. Published by the Association of Building Technicians, 5 Ashley Pl, S.W.1. 144 pages (excluding maps and diary), 4¼ in. by 3 in. Price 5s. 4d. (for members 3s. 10d.).

**The Load on Top Management—can it be reduced?** by L. Urwick. Analyses factors which have increased the load of responsibility and effort called for from top managers in industry, and suggests nine steps towards a solution. Published by Urwick Orr and Partners Ltd., London, 50 pages, 8¼ in. by 5½ in. Price 2s.

**Mass Spectrometry,** by A. J. B. Robertson. Gives general introduction to the subject, as part of publisher's series of monographs on chemical subjects. Published by Methuen, 135 pages, 6 in. by 4¼ in. Price 8s. 6d.

**Generation and Transmission** by C. S. Beckett. New edition of a well established textbook which has been revised in light of present day practice. Third edition, published by Blackie, 124 pages, 8½ in. by 5¼ in. Price 8s. 6d.

# PROBLEMS AND PRACTICE

## In Engineering

*Every engineer has a story to tell; why not tell yours on this page? We welcome contributions to this feature, and those published will be paid for at our standard rates. Problems which are encountered and overcome in day-to-day maintenance or installation of electrical plant; useful methods and techniques developed for specific jobs, or current practices, all make instructive reading for others. We will also consider for publication problems requiring an answer. Sketches are often helpful and need only be rough, as they will be redrawn before use.*

### 'Amateur' Work

THE following incident is, I feel, valuable in the manner in which "amateur" work can lead to danger. I was called out to a house to attend to the lamps in bathroom and scullery which were not lighting. Originally the occupier had purchased a length of flexible cord to extend an existing lead on a bedside fitting. He had joined the two cords together without any insulating material between both conductors and, in consequence, the resulting short-circuit blew the circuit fuses as soon as the supply was switched on. After disconnecting the bedside lamp from the supply, he repaired the fuse, but then found that after switching on again, all other lamps worked except those in bathroom and scullery even when new lamps had been fitted, and at this stage, I was called in to put the lights in proper order.

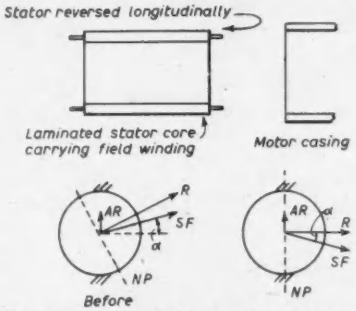
The lighting installation had been carried out with lead sheathed cables, using suitable junction boxes. It had been wired in conventional manner, and examination showed a "live" conductor at each switch, whilst all switches and lamps were in good working order. I then concluded that the neutral was most likely broken between the two faulty points and the supply.

At the junction box feeding these lamps and switches, the neutral conductors were found to be connected and insulated with a "medium" porcelain connector, in which the wires had become detached, so that the neutral wire from the supply was disconnected from those running to the bathroom and scullery ceiling roses, although they were still held together. After investigation of these connections, and others, I found that perished and consequently soft and sticky rubber tape had originally been used for insulation then had been left on the joint when the connector was applied to it. From this it was obvious that a high resistance joint had resulted which showed its weakness when the short circuit current flowed through it.

As far as I could gather, the original installation had employed both rubber and black adhesive tapes for insulating joints, metal junction boxes having been fixed at a later date. When this work was carried out, the connections should, of course, have then been freed from all perished rubber tape, the wires cleaned and the joints re-made, but the connectors used, unfortunately, were not of the correct size for the conductors, which presumably, explains why the tape was left on. However, I cleaned all connections in the box, fitted the correct size connectors and tried the two lights to ensure that all was well—and it was. As the fuse had been repaired by the occupant of the house, as a final precaution, I examined it carefully, but it had been re-wired correctly.—*J. H. Robinson.*

### Universal Motor Winding

I RECENTLY investigated an electric drill motor (a.c. universal series type) which had been sent to the workshop for an armature rewind. Upon its return it was found that there was sparking under the brushes and that it did not come to speed when connected to run in the right direction of rotation. We changed the leads of the armature and found that it picked up speed and the sparking was absent though the motor was running in the wrong direction. From the fact that sparking was absent it was clear that no electric fault existed in the armature winding. It was equally clear that while running in the right direction the brushes were not in the neutral plane.




*Sketch showing longitudinal reversal of stator and vector conditions before and after reversal*

Upon inspection it was found that the brushes could not be adjusted and were rigidly fixed. An inspection of the field winding, which was of a distributed type, revealed that it was fixed and could not be adjusted.

The motor behaved normally when the field winding complete with laminated core was removed from the body, turned around longitudinally and reinstalled in the casing. The explanation seems to be that the field winding is wound in such a way as to produce a field displaced by an angle and from the line perpendicular to the brush axis which, after combining with the armature reaction, produces a neutral plane coinciding with the plane of the brushes.—*H. Rand.*

### Electrode Steam Raiser

AFTER reading Mr W. Satchwill's very interesting account of the overloading of an electrode steam raiser, due to the concentration of impurities in the water, I think it should be pointed out that the electrical resistance of local water supplies varies greatly and that no general rule regarding the periodic draining of this type of steam raiser can be laid down. In some localities it may be unwise to drain except at rare intervals.

I have in mind a particular steam raiser of exactly similar type to that described by Mr Satchwill but having a full load rating of 30 A. This raiser when first commissioned would, owing to the nature of the local water, only pass 5 A, and it was necessary to add an appreciable amount of washing soda to the water to lower its resistance before the full load of 30 A was indicated on the ammeter. In this instance, it was necessary to instruct the user to merely top up the steam raiser after each operation, and to only drain a small amount of water from the steam raiser at infrequent intervals, or whenever the ammeter began to indicate more than 30 A.

After working satisfactorily for twelve months, this raiser was drained for an internal inspection, and after refilling it was again necessary to add soda to the water, so the opportunity was taken to add a cock, to the upper part of the boiler, through which soda solution could be easily introduced whenever necessary.—*T. H. H.*

### Refrigerator Operation

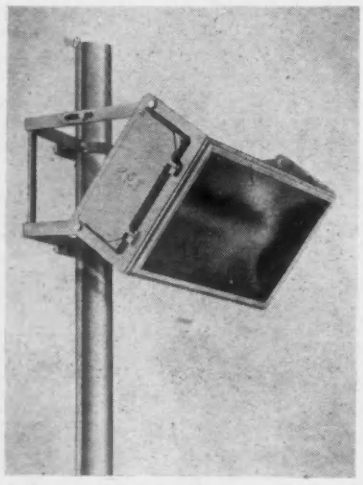
THERE must be thousands of ice-cream conservators operating, without the indicating signal light which is incorporated in some makes of latest models. With the older models the user cannot, therefore, tell whether the unit is operating or not, and on many occasions a blown fuse has not been noticed until after the contents of the conservator has been spoiled. It is an easy matter for an electrician to wire up a small neon indicator lamp to operate with the thermostat switch thus indicating when the unit is operating. This may, of course, be located in any remote part of the premises as most convenient. On some occasions, and for some users, it may be desirable to install two lamps, connected to each side of the control switch, one for telling the user that current is available at the unit, and the other to indicate the operating periods of the unit.—*B. Quarmby.*

# *Equipment for Industry*

## Lantern for Dock or Quayside

DURING the waiting time whilst ships are in dock, opportunity is often taken to effect repairs and, due to the limited time available, much of the work must of necessity be carried out in hours of darkness. For these operations, a high level of illumination is essential, particularly if detailed work is involved. GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2, have recently introduced a new lantern which is particularly suited to such tasks in addition to the more normal duty of lighting quays or docks.

The lantern consists basically of a curved anodised aluminium reflector held in position by two end castings and a tie bar assembly. A door in each end casting provides access to the two 400 W horizontal burning mercury lamps, thus obviating the necessity to remove the front of the lantern for servicing purposes. In view of this, the cast aluminium frame which supports the toughened roughcast diffusing glass is rigidly secured to the main body of the lantern by many small holding screws. The illustration clearly shows the fixing arrangements, which although, as standard, are suitable for mounting on a 3 in. dia. post, may be varied to suit customers' requirements. The fixing gear also allows for angular movement of the lantern from between 20° and 50° below the horizontal.



*Fixing gear and provision for angular movement of lantern below the horizontal are clearly shown*

## Reliable Miniature Relay

GREATER efficiency and more compact design are claims made by P.A.R. LTD., 95 Talbot St, Nottingham, for their new miniature power relay. Developed for use in electronic apparatus these relays are suitable for applications where constant switching is required. Production models are said to have been subject to ½ million operations without failure. Two models are made, the type "M" with a consumption of 0·85 W rated at 2·5 kW, and a more sensitive model for which the respective figures are 0·5 W and 0·75 kW. Operating time is in the order of 25 to 40 millisecs. Although in standard form these relays are open, for special applications, where more protection is required, they may be supplied in sealed cans.

## Thermoplastic Tubing

A NEW lightweight plastic tubing called "Marleythene" is being produced by the MARLEY TILE CO., LTD., London Rd, Riverhead, Sevenoaks, Kent. Since the material is claimed to have good electrical and thermal properties, such applications as sheathing of pliers handles, or use as gaskets or washers, readily lend themselves. Raising its temperature, causes the tubing to become ductile, allowing it to be moulded and almost invisible joints to be made. The material is, however, unsuitable for use with hot water. Advantages of working the material may be seen since it may be cut or turned and when in service is said to be non-corrodible and to have a long life without ageing. It is made in three colours, natural (translucent), white or black. The makers state that tubes having the first two of these colours should not be exposed to direct sunlight.

## Junction Transistors Available

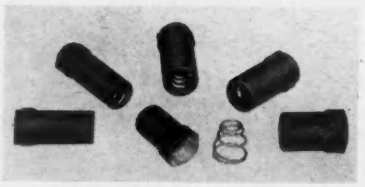
ALTHOUGH the junction type transistor represents a considerable improvement in terms of performance over the point contact type, mass-production of these components has resulted in the introduction of difficulty of obtaining uniform characteristics. Considerable research by MULLARD LTD., Century House, Shaftesbury Ave, W.C.2, has led to the production of two junction transistors which are now available in large quantities and a high degree of consistency of performance is claimed. Widely used in hearing aids, investigations are in hand to extend their use to telephone circuits and computers. Of the two types produced, OC70 is intended for use in microphone input and amplifying stages and OC71 for output stage of telephone earpieces and hearing aids. Both types are hermetically sealed and measure 0·6 in. long by 0·25 in. dia.

## Dispenser for Feeler Gauges

DISADVANTAGES attendant with the normal fan type feeler gauges are said to have been overcome with the introduction of the new dispenser manufactured by RUBERT AND CO., LTD., Chapel St, Levenshulme, Manchester. Pressing down a clamp releases the blades from the case, thus allowing selection of the particular gauge, and on releasing pressure, this may be clamped in any position desired. Fifteen sizes are available ranging from 0·001 in. to 0·025 in. Dispensers may be supplied in polished brass or chromium plated, but both are fitted with a pocket clip.

## New Valve Screen Range

PRIMARILY designed for use in service electronic equipment, a new range of valve screens and associated coil springs, now available generally, are made in the three standard lengths recommended by the Radio Components Standardisation Committee to suit B7G or B9A valveholders. They may also be supplied in either aluminium or brass, for use with cadmium or silver-plated skirts respectively, and in the case of the brass type, the inside contact face is silver-plated. Finish, both inside and out, on both types for all except the contacting surface, is stove enamelled matt black, which assists in dissipating generated heat. An initial contact resistance of 50 milliohms between skirt and screen is claimed, this value is said to be well below the allowable 100 milliohms after tropical exposure. Inter-Service Type approval (Category H 1) has been granted to the complete range of screens, which are available from the PLESSEY CO., LTD., Ilford, Essex.



*Some of the twelve different sizes included in the new range of Plessey valve screens*

## Cable Range Extended

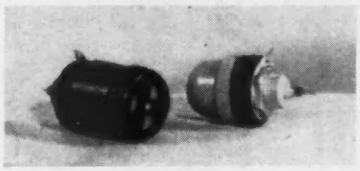
MASS-IMPREGNATED non-draining paper-insulated cables manufactured by CROMPTON PARKINSON LTD., Crompton Hse, Aldwych W.C.2, are now available for working on all voltages up to and including 11 kV. All cables manufactured in this range conform with the relevant C.M.A. and British Standard specifications. These cables have excellent non-bleeding characteristics and are usually employed in installations having either vertical or steep-gradient cable-runs. They are available in both screen and belted types.

## New Sealed Lampholder

A NEW lampholder, designed primarily to hold lamps with standard M.E.S., for use on radio and electronic equipment, is being made by the PLESSEY CO., LTD., Ilford, Essex. Of robust construction, the lampholder conforms to B.S.98:1947, and is suitable for use in a panel of any thickness up to a maximum of 1/8 in.

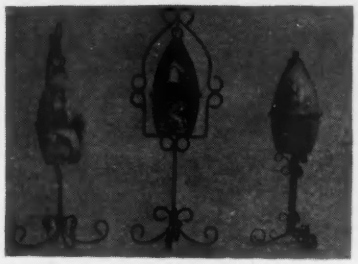
The body of the holder, sealed to exclude moisture, is machined from brass and insulated from the panel. Centre contact of spring-tempered beryllium copper, insulated from the body by a perbunan seal, completes the circuit to the bulb.

*The dimmer attachment cap left and the plain lampholder cap right*



Two interchangeable caps are available. The first is a ureaformaldehyde moulding supplied in a wide variety of colours to suit individual requirements. The second is a dimmer cap which consists of a light alloy diecasting fitting with a plastic filter coupled to a shutter. Rotation of the filter, also available in many colours, enables the quantity of light transmitted to be varied from maximum to zero. Lampholder rating is 3·6 W.

*The "Feather" fittings to which we refer in the next column*



## TRADE PUBLICATIONS

TIME CONTROL.—A comprehensive brochure on Siemens Time Control and Master Clock systems has been released by Siemens Electric Lamps Supplies Ltd. (2B/54), 38 Upper Thames St, E.C.4.

BEARINGS.—Details of RMB Swiss Miniature Bearings are found in leaflet B-401 issued by Miniature Bearings Ltd., 4 and 5 William IV St, W.C.2.

DIESEL GENERATORS.—New publication DE/190 describes three types of mobile generating sets by English Electric Co., Ltd, Brownsover Hall, Rugby, or from Publicity Dept., Foregate St, Stafford.

APPRENTICESHIP.—New and enlarged brochure issued by Dewrance and Co., Ltd., Great Dover St, S.E.1, describes the firm's apprenticeship scheme in operation at the London, Dumbarton and Hillingdon Works.

## Novelty Lamps

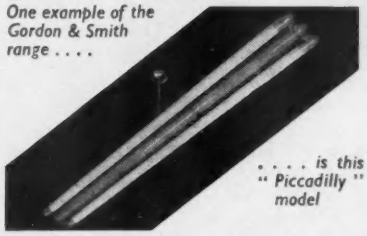
INTERESTING novelty lamps fabricated from wrought iron are included in the range of goods produced by M. J. FEATHER LTD., Otley, Yorks. The three lamps shown in our illustration are unique. The lamp casing is made from steel, the light being emitted from the small windows which can be fitted with coloured glass, and from the doorway in which a model squirrel is sitting.

The uses of these lamps in window and shop displays in bazaars and in the nursery and children's rooms as a night light will be appreciated by our readers. Sole selling agents are Coombs Goring and Co., Ltd., 336 Lillie Rd, W.6.

## Compact Fluo Fitting

FLUORESCENT fittings of tubular shape have now been made available to the home market by GORDON AND SMITH, Sidmouth Mews, Gray's Inn Rd, W.C.1. The type of construction introduced several years ago when there was only one model, is again employed but with a number of improvements. The range has been extended to size models employing both 2 ft 20 W and 4 ft 40 W lamps.

*One example of the Gordon & Smith range . . . .*



*. . . . is this "Piccadilly" model*

The main body of the fitting is an aluminium tube 1¾ in. diameter. Control gear employed is the usual type but specially designed to fit into the small space of the tubular main body. Die cast arms with attached lampholders, one fixed at each end of the body of the filling, which is completed by the attachment of an end cap. Similar end caps slide over the tubes. Standard finish is hand baked pale ivory stove enamel but anodised aluminium finish is available.

## Ekco Price Changes

THE prices of Thermovent unit heaters and 1 kW floor standing and inset convectors have been increased by E. K. COLE LTD., 5 Vigo St, W.1. New total prices are as under:

| 1 kW convectors (inc. tax) | | Unit-heaters (tax free) | |
|---|---|---|---|
| FRI | £10. 11s. 9d. | TU/3 | £14. 6s. |
| FRCI | £12. 5s. 10d. | TU/5 | £20. 18s. |
| SRI | £9. 18s. 1d. | TU/9 | £24. 4s. |
| SRCI | £11. 5s. 4d. | TU/12 | £25. 4s. |
| BI | £11. 5s. 4d. | TU/15 | £26. 5s. |
| BCI | £12. 19s. 6d. | | |

## The "Mystovector" by French

FIRE turned convector is a literal description of the unusual "Mystovector" heater designed and marketed by W. T. FRENCH AND SON, LTD., "Mysto" Works, Birmingham 16.

The element of the fire is concealed in a hood which ensures that constant heat is circulated to the air above and beyond the fire whilst a gently sloping reflector throws out heat at the front and sides.

The element itself is screened by a guard thus leaving the reflector free for easy cleaning, a factor of annoyance in many of the designs available today. Whilst weighing only 8 lb, the "Mystovector" is safe and stable. It measures 15 in. x 14 in. x 13 in., and is available in alternative finishes of attractive hammered gold and hammered silver. Price is £5. 8s. 11d. inc. tax.

***For the Electrical Trade***

## Warm-Glow Window Demister

LOW in costs, both installation and running, the window demister unit priced at 36s. and just introduced by THE WARM-GLOW CO., LTD., Leigh-on-Sea, Essex, will repay its cost time and time again in business created by clear, mist-free windows, focusing public attention.

This handy device consists of a specially designed flexible cable which gets *warm*, not hot, when in circuit with the mains. Half as thick as a pencil and insulated in special flameproof plastic the cable emits heat which rising by convection will keep the window clear.

Each unit is boxed complete with full instructions and ready to plug-in. Guaranteed 12 months and for ac/dc supplies the cable comes in two models DM.1 (200–220 V) for window frontage 22 ft and DM.2 (230–250 V) for window frontage 25 ft.

## G.E.C.'s 1½ pt. Percolator

STYLISH new 1½ pt coffee percolator is latest domestic appliance by the GENERAL ELECTRIC CO., LTD., Magnet Hse, Kingsway, W.C 2. Made in heavy gauge copper chromium plated the percolator is provided with black Bakelite heat insulating handle and feet. Loaded at 400 W and priced £6. 5s., the new percolator incorporates an automatic re-set protective device against boiling dry.

# NEWS OF THE WEEK

## Street Lighting Firms Accused

### *TWO COUNCILS ALLEGE PRICE-FIXING BY TENDERERS*

SUSPICIONS have been aroused of price-fixing by firms submitting tenders for street lighting contracts. Although this may be difficult to understand in a branch of the electrical industry which is generally considered as one of the most competitive at the present time, it is none the less true that two cases have occurred within the past two weeks in which local authorities have drawn attention to identical quotations, and asked that the matter be investigated. The two contracts involved are at Wembley and Thurrock (Essex). At Wembley tenders were invited for the conversion of 400 gas lamps to 471 sodium lighting units including concrete columns, and the work is valued at about £14,000. At Thurrock the work involved lighting the main London to Tilbury trunk road—costing a total of about £8,500—and the lighting of various classified and district roads at a cost of about £20,000.

Confronted with the various tenders, Wembley councillors soon discovered that several individual items in the tenders of six of the seven firms concerned, were quoted at identical amounts. The total amounts in the tenders are understood to have differed. The Council asked that the similarities be investigated, and accordingly a letter was despatched to the Board of Trade last Thursday suggesting that the matter was one for the Monopolies Commission.

An independent street lighting authority pointed out that similarities could easily occur in certain cases where firms had been asked to tender for the complete job of supply, erection and installation. It might well be, it was stated, that the same sub-contractor had been called in, or that the Electricity Board had been asked to submit an estimate by a number of prospective contractors. There was also in existence a price basis, adopted by many manufacturers, for certain types of fittings. Any suggestion of "ganging-up" on the part of firms was considered extremely unlikely.

Nevertheless, the similarities in quotations received by Thurrock U.D.C. are understood to involve the supply of actual equipment as well as incidental works, and if the figures were not always identical, they differed by a mere penny or twopence. The figures have been referred to the Highways Committee, and similar action as that taken by Wembley, may follow.

In the annual report of the Monopolies Commission for 1953, electric street lighting equipment was one of a number of subjects in which it had been alleged that agreement existed among some suppliers to observe prescribed common or minimum prices.

### New Year Building Show

THE first building exhibition of the New Year will open at Workington on 3 Jan. Displays will be provided by the N.W. Electricity Board, Coal Utilisation Council and N. Gas Board.

### Extra Safeguard imposed on Exports to Soviet Bloc

ADDITIONAL safeguards to ensure that strategic commodities do not reach the Soviet Union or China have been taken by the Board of Trade. Last October it was announced that a substantial reduction had been made in the lists of goods which could not be exported to the Eastern bloc, and trade between the U.K. and the Soviet thus became a good deal more lenient. The latest control imposed merely concerns the same banned goods but extends the scope of restrictions to articles which do not originate or pass through the U.K. en route to Russia or China. The new Order takes effect from 7 Jan. next. It is the Strategic Goods (Control) Order 1954.

### UNIPEDE Congress in London Next Year

TENTH congress of the International Union of Producers and Distributors of Electricity, known as UNIPEDE, will be held in London next year. Lord Citrine, chairman of B.E.A., will preside. The working sessions of the congress will extend from 19 to 23 Sept., and will be held at Church House, Westminster. A number of study tours to various places in England, Wales and Scotland are being arranged to follow the technical sessions. It is expected that some 400 delegates will attend the congress.

## *Eastern Board's Tariff Increases Considered*

CONSIDERATION of the Eastern Electricity Board's proposals to increase their standard tariffs as from 1 Apr. next were completed by the general purposes committee of the Area Consultative Council at a meeting in London last Friday. The committee were not entirely in agreement with the proposals and have made a number of recommendations. Although these recommendations have not been endorsed by a full Council meeting, they have been forwarded to the Board, whose reply will be considered at the January meeting. A warning that the Eastern Board intended to raise their tariffs was reported in our issue of 9 Sept. One of two Boards who made a deficit in the last financial year, it is estimated that in the ensuing years until 1957 an additional £3 million a year will be required. That sum will have to be raised by uplifting all tariffs in proportion.

At the same time the Eastern Consultative Council are drawing attention to the fact that they feel hampered through not being able to call for details of the make-up of the bulk supply tariff. They are seeking a declaration from the Minister of Fuel and Power that Councils are entitled to information which enable them to discharge their duties effectively, particularly as the bulk supply tariff is the cause of "such phenomenal increases in costs over which the Boards have no control." They point out that whilst Boards are being urged to sell electricity under the maximum demand tariff on a monthly basis, they have to pay the Central Authority on an annual basis.

### Middlesex Protest on Charges for Small "Homes"

ANOTHER matter considered last week by the Eastern Electricity Consultative Council was a protest from Middlesex County Council concerning charges for electricity in respect of children's and old people's homes. They contend that the development of the Welfare State has demanded that those homes should be small units, and consequently many small houses have been acquired to accommodate between six and ten persons. Despite the fact that these homes are almost the same as any ordinary private household, they have nevertheless been placed on the commercial tariff.

The Consultative Council has referred the matter to the Board and suggested that a national decision should be made on the subject by the Central Authority.

## B.E.A. willing to Help in Fight against Pollution

FOLLOWING the publication of the Beaver Committee's report on Air Pollution, the B.E.A. has considered the recommendations, and last weekend issued a statement outlining their current policy on the subject. Of particular interest, of course, was the committee's proposal that gas washing should be introduced at all new power stations.

The Authority points out that it has not been established as yet that gas washing can be effectively introduced. Moreover, as the committee itself recognises, complete removal of sulphur dioxide from power station gases would still leave over three-quarters of the sulphur problem unsolved. Pending more detailed consideration of the recommendations, the B.E.A. is submitting relevant factors to the Government, including the heavy capital cost which, covering also further grit arresting installations, could not be less than £140 millions, and might reach £250 millions, within the next ten years. This, coupled with the extra operating costs, is likely to involve an increase of at least 12% in the cost of generating electricity, the statement explains.

Despite these factors, the B.E.A. state they are prepared to face the financial liability involved when they are satisfied that it is the right course to pursue in the national interest for the public health. The statement concludes: "Whatever the Government's decisions, the Authority will loyally and energetically seek to implement them."

## MONOPOLIES INQUIRY INTO VALVE INDUSTRY

THE supply of electronic valves and cathode ray tubes has been referred to the Monopolies and Restrictive Practices Commission. This new reference was announced by the President of the Board of Trade in a written answer in the Commons last Wednesday. Any person or organisation having evidence to offer is invited to contact the Commission's Secretary at 3 Cornwall Terrace, Regent's Park, London N.W.1.

To date the Commission has investigated two aspects of the electrical industry, namely lamps and insulated wires and cables. In addition inquiries are proceeding into the supply of electrical and allied machinery and plant, whilst investigations into semi-manufacturers of copper and copper-based alloys also have a bearing on the industry. Thus of 18 references submitted so far, five affect the electrical industry.

As regards the latest reference, it will be recalled that a White Paper entitled "Prices of Radio Valves" was published in 1946.

## *£600,000 allocated for Expansion of U.K. Factory*

A SUM of £600,000 has been allocated by the General Motors Corpn. to its AC-Delco factory at Dunstable, Beds, for extending the premises. That allocation is part of a £3 million expansion scheme announced by the Corpn. in Detroit last week. Products of the AC-Delco Division include electric motors and a wide range of motor car accessories. It is expected that the present Dunstable factory will be extended by about 200,000 sq ft. The Division already occupies 315,000 sq ft at Dunstable as well as 92,000 sq ft at Southampton. Planning permission for the expansion scheme is to be sought immediately, and the number of employees will probably be increased gradually above the 2,300 already at work there.

## 1955 Canadian Trade Fair opens on 30 May

THE eighth Canadian International Trade Fair is to be held in Toronto next year between 30 May and 10 June. As the only regular international trade fair held in N. America, little need be said of the opportunities provided by this Toronto exhibition. They are already well known as are the scope and prospects provided. The Fair caters for capital goods, and a variety of consumer goods. Of all the sections, engineering and machine tools will be by far the largest. Innovation next year will be a comprehensive welding and metals section, which will be included for the first time.

Interested U.K. manufacturers who have agents in Canada can contact the Fair's Administrator, Exhibition Park, Toronto 2B, Ontario, through those agents. Others can write to the London representative, Mr W. G. Pybus, Canadian Govt. Exhibition Commission, Canada Hse, Trafalgar Sq, S.W.1.

## Summer Meeting of Physics' Group

NEXT year's Summer Meeting of the Institute of Physics' Non-Destructive Testing Group is to be held at the Royal Technical College, Glasgow, between 22 and 25 June. Works visits and an afternoon or evening excursion will be arranged with the Institute's Scottish branch. An invitation is being extended for suggestions in choosing the subjects of papers. It is proposed that one or more papers should deal critically with the physics of a non-destructive testing method, and at least one dealing with metallurgical or engineering applications. In view of the success of the Forum last year, it will be reintroduced next June. Suggestions should be sent as quickly as possible to joint hon. secretary of the Group, Mr B. R. Byrne, c/o British Transport Commission, B.R. Research Dept, Ashford Works, Kent.

## OFFICIAL PUBLICATIONS

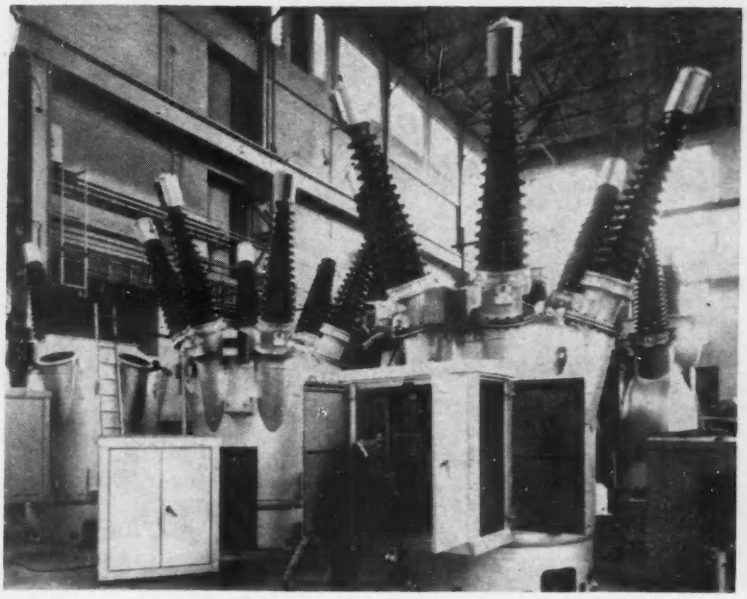
PARLIAMENTARY BILLS

N. Wales Hydro-Electric Power Bill, price 3s., (see page 882); and Blyth Generating Station (Ancillary Powers) Bill, price 2s., (see page 905). Both available from Parliamentary Agents, Dyson, Bell and Co., 15 Gt College St, Westminster, S.W.1.

FIRE RESEARCH TECH. PAPER No 2.

Report of Committee on Vaporizing Liquid Extinguishing Agents. Published for DSIR by HMSO 1s.

STRATEGIC GOODS (CONTROL) ORDER, 1954. S.I.1622. (See page 900). HMSO 9d.



*This photograph, taken inside the British Thomson-Houston Co., Ltd.'s Willesden works, shows oil circuit-breakers being manufactured for the North of Scotland Hydro-Electric Board. Particular interest lies in the fact that all three phases will be housed in one tank. The 132 kV 1,500 MVA Shuntarc breakers are scheduled for installation at Brechin*

## Judges Named for Sign Competition

PANEL of judges in the illuminated sign design competition were announced by the sponsors, the Electrical Sign Manufacturers' Association, last week. Aims and objects of the competition were reported in our 28 Oct. issue. There will be five judges, namely, Sir Hugh Casson; Mr Misha Black, nominated by the Council of Industrial Design; Mr E. H. Doubleday, president of the Town Planning Inst.; Mr Norman Moore, president of Advertising Assoc.; and Mr J. H. G. Pearce, chairman of E.S.M.A.

To date there has been an excellent response and a large entry appears certain. Over a thousand copies of the rules and entry form have been despatched as well as about 400 copies of the perspective drawing and site plan. Closing date for entries is 31 Jan. There are prizes of £100, £50 and three of £25, at least one of which must go to an amateur designer, and these will be presented at the Association's annual lunch on 9 Mar.

## *Farmers show Keen Interest at Smithfield Show*

THE very wet summer and autumn was given as the probable reason for the attendances at the E.D.A.'s stand at this year's Smithfield Show, which took place at Earls Court, London, throughout last week. The number of visitors was said to have greatly exceeded any previous experience. Specially featured in the display were the various methods of crop conservation by electricity. There were of course the expected enquiries, but far more surprising was the large number of orders given for very large grain drying plants; namely, those with capacities of 600 tons or more. On one day alone four firm orders for plant of this capacity were obtained. There was also phenomenal interest in barn hay drying by electricity, and at times farmers queued to question experts on this method of saving their crops. About 2,000 enquiries were dealt with on one day.

## *Mrs E. Lectric Cooking Introduced to Perth*

A WELL-PLANNED advertising campaign aimed at capturing the gas-conscious city of Perth has proved to be an outstanding success. The North of Scotland Hydro-Electric Board, who organised the campaign, found that many Perth residents still used gas for lighting and some did not even know that electricity could be used for cooking. Highlight of the campaign was the mysterious Mrs E. Lectric Cooking, a member of the Board's office staff at Dundee who was left to wander around the city until recognised. The first person to spot her was given a suitable prize. Poster displays and leaflets exhibited before the cooker week started excited the public's interest to such an extent that on the first day Mrs E. was spotted by a housewife within 20 seconds of alighting from her car.

One of the difficulties discovered by the Board in the past was the public's reticence in entering an electricity showroom to make enquiries. Consequently emphasis was placed on personal contact. Experienced salesmen called on thousands of housewives, both consumers and potential customers. Direct sales were made, not only of cookers, but of a wide range of electrical appliances. The salesmen were also able to discuss wiring problems and offer advice on the spot.

*Mrs E. Lectric Cooking congratulates a successful challenger in the North of Scotland Board's cooker campaign in Perth*

Exhibitions and demonstrations were held at five halls in the city, and the week ended with a concert and demonstration attended by some 600 persons. Co-operating with the Board in their efforts were the G.E.C., Revo Electric, British National Electrics, Simplex, Jackson Electric Stove Co., and English Electric.

### SHOWROOMS AT PATCHWAY

IN response to persistent requests from residents at Patchway, the S. Western Electricity Board has now opened a new service centre there. It will serve a wide area including Stoke Gifford, Almondsbury, Tockington and Olvesten, all of which are several miles from Bristol, formerly the nearest electricity offices. In charge of the new showrooms will be Mr H. Guy, a local resident, who will in fact be the whole "staff." The showroom was opened last week and until the weekend there were washing machine and cookery demonstrations daily. Local housewives were invited to take along some of their washing and have a rest from washday worries.

## Bankside House Subject of Rating Complaint

YET another case of disagreement over rates between a local authority and the supply industry has occurred. It concerns the B.E.A.'s large block of offices opposite Bankside power station which is exempt from the rating provisions of the Local Government Act, 1948. Southwark borough council are complaining that the loss of rates on that site is serious, and maintain that offices used as headquarters for the whole of the country should be brought within the rating provisions. The council has duly made representations to the Association of Municipal Corporations. The association has reported that while they are in sympathy with the views expressed concerning the inadequacy of existing laws relating to the rating of premises used by nationalised boards as part of their central organisation, they consider it would be unwise to take the matter further at present. The report adds that the question would be borne in mind when any Bill dealing with rating generally was under consideration.

## E.A.W. Silver Jubilee

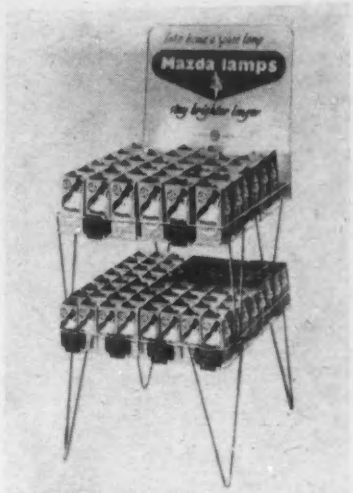
HARTLEPOOLS branch of E.A.W. celebrated their silver jubilee recently with a luncheon. Branch president, Mrs G. K. Wainwright, J.P., presided.

*Part of the E.D.A.'s stand at the Poultry Show at Olympia. In the foreground is an infra-red lamp for brooding, and demonstrations of deep freezing, featured in the rear, were given throughout the day. The Association also erected a demonstration kitchen at the Show, where Miss Marguerite Patten, the TV cookery expert, provided plenty of interest for visitors. The Show took place on Wednesday, Thursday, Friday, last week*

## Scottish Co-op to specialise in Electrical Shops

THE establishment of a number of specialised electrical appliance shops is being carried out now by a number of Scottish Co-operative Societies, it is reported from Glasgow. The Societies are adopting a policy of specialisation, allegedly to compete with the specialised private trader. Hitherto, of course, electrical equipment has found its place among the furnishing, household goods and similar departments of the Co-operative store. We hear that in the past few weeks several new electrical shops have been opened and a number of others will probably follow in the near future. One of the most recent is at Wishaw where two shops have now been converted into a single electrical department handling all kinds of appliances, fittings and radio and television sets and apparatus.

A notable aspect in the new Wishaw shop is that while one part has been devoted to display, the second has been set aside for repair and maintenance. The Co-operatives are paying more attention to the repair and maintenance side of the trade and are already handling a considerable volume of business. The major markets which it is hoped to recapture from the private traders concern washers, dryers, mixers, radio and television. As far as can be ascertained there is no indication of the adoption of a similar policy south of the Cheviot Hills.




*Simple, attractive yet severely practical is this new sales aid produced by BTH for Mazda lamp dealers. The two wire trays hold about 100 lamps and can be used separately if required. It incorporates a three-colour showcard and tags giving types, wattages and prices which can be clipped to the trays. Provision is also made for lighting lamps. Construction is of heavy gauge wire*

## E. Anglian Electrical Association holds 21st Dinner

IPSWICH Electrical Association held its 21st annual dinner recently with Mr H. E. Wright, chairman, presiding over a gathering which included many noted personalities among the 240 members and guests present. Among the guests were Mr A. F. Plummer, president of E.C.A., who proposed the toast of the Ipswich Assoc. A toast to the electrical industry was proposed by 86-years-old Mr E. P. Tetwall who mentioned the increasing strain now being placed on the supply of coal. He said there were not the natural forces in this country to build great power stations as in Canada and Sweden, and the strain would continue until atomic energy took over. Who better to reply than the Assoc's president Mr C. T. Melling. The dinner was also graced by the presence of the Mayor of Ipswich and Dr A. H. Morris, Lord Bishop of St. Edmundsbury and Ipswich. The latter readily agreed with the suggestion that church lighting could be much improved, but it appeared to be a specialised task, calling for particular consideration of the architecture of buildings.

### SCOTTISH CABLE CONTRACT

VALUE of paper insulated cables required by the S.W. Scotland Electricity Board in the 12 months beginning on 1 Apr., 1955, is over £800,000. This valuable contract has been placed with Scottish Cables Ltd., it was announced last week.

## The First Half-Century

Dear Sirs—It having been pointed out in many quarters that the electrical industry, although very wide reaching and giving employment and occupation to many thousands of individuals in all grades of life, has in connexion with it no means of supporting any of those unfortunate members of it who fall into temporary or permanent need, an influential committee of gentlemen actively connected with various branches of electrical work has been constituted to organise a benevolent fund for the industry. As soon as a sufficient sum is available this fund will eventually be used for the purpose of providing pensions and donations for deserving cases in the electrical industry, voted for by the subscribers. Further details will shortly be announced, but in the interval the organisation is being rapidly proceeded with. Yours faithfully, Justus Eck.—*From our issue of 15th December*, 1904.

## *New Certificate for Plant Engineers*

PLANT engineers are to be catered for by a new examination organised by the City and Guilds of London Institute. The scheme is intended to meet the needs of those engaged in the selection, installation and control of plant thoughout industry. In general, the examination courses are intended to follow on the successful completion of an Ordinary National Certificate course in electrical or mechanical engineering. The courses have been approved by the Council of the Incorporated Plant Engineers as meeting their examination requirements for Associate Membership of that body.

Details of the course of study may be obtained from the Department of Technology, City and Guilds of London Institute, 31 Brechin Place, London, S.W.7. It is spread over two years divided into three groups: mechanical power distribution; mechanical energy generation; and electrical energy distribution and generation. Certificates in plant engineering will be issued to those who pass in the first group and in either of the others. In the first group there will be two papers, mechanical plant and pumping and hydraulic plant, and steam and refrigeration plant. There will be two papers ranging over the whole field in the electrical group. It is emphasised throughout that the syllabus laid down should be treated from the viewpoint of the plant user seeking efficiency under running conditions and not from that of the designer and manufacturer. Up to one-third of the attendance time at a technical college is required to be spent in laboratories and workshops.

## New Cable Merger?

THE General Cable Manufacturing Co., Ltd., of Leatherhead, has offered the sum of £425,440 for the shares of the Britannic Electric Cable and Construction Co., held by Radio and Television Trust, Ltd. The board of the latter concern has formally accepted the offer (as we note on page 906).

## Special Courses Starting in Spring Term

NOTICES have been issued concerning special courses in Liverpool and London to be held early next year. Three of the four included in the syllabus for the spring term at the University of Liverpool are of interest. They are on Refractories, a series of nine lectures to be given each Tuesday from 11 Jan.; on An Introduction of Servomechanisms, eight lectures also on Tuesdays as from 18 Jan.; and on The Design and Analysis of Scientific Experiments, ten lectures on Wednesdays beginning on 12 Jan.

Two notable courses arranged by the Northampton Polytechnic, London, are Liquid Fuels—their Properties and Utilisation, and Recent Developments in Metal Finishing. These begin on 4 Jan. (8 lectures) and 3 Jan. (7 lectures) respectively, and the fee in each case is £2. 2s. Others beginning in the spring term at the Polytechnic are a Laboratory Course in Refractory Technology (6 Jan.) Heat Transfer with special reference to Fuels (24 Jan.), and Materials of Construction (27 Jan.).

# NEWS IN BRIEF

Next year's Building Plant Exhibition organised by the Ministry of Works will be held on the Queenslie industrial estate, Glasgow, between 8 and 15 June.

Improved lighting of docks and marshalling yards as an aid to quicker handling of freight, was the subject of a talk by Mr W. T. Souter of Holophane Ltd to the Glasgow I.E.S.

Equipment for complete broadcasting station for Radio National de Peru is to be supplied by Redifon Ltd.

Trends in Heat Pump Design was the title of Mr J. A. Sumner's lecture to the Chelmsford Engineering Soc. earlier this month. Mr Sumner is manager of Eastern Board's Norfolk sub-area.

Just over 150 sat down to the annual dinner of the E.C.A.'s Tunbridge Wells branch. Dancing continued until 1 a.m.

New loudspeaking and intercom equipment for both Renfrew and Ringway airports has been installed by Hadley Sound Equipments Ltd.

Visitors to the 1955 *Daily Mail* Ideal Home Exhibition will enter a metropolis of Regency Times. We are told it will be difficult to escape the illusion that one is living in the London of our great-great-grandparents when encountering rooms of such celebrated persons as the Duke of Wellington, Mrs Fitzherbert, Beau Brummel and Sheridan.

Prior to the football match between Wolverhampton Wanderers and the Russian Spartak team, the latter carried out a part of their preparatory training programme on Revo Electric's football ground and were highly complimentary about the floodlighting installed there.

Staff of the meter department of the Derby and Buxton sub-area of the E. Midlands Electricity Board have held their first dinner and concert at the Irongates Hotel, Derby.

Developments, progress and past and present activities are recorded in a brochure produced by Dussek Bitumen and Taroleum Ltd. to mark their 50th anniversary.

Commissioner-in-Chief of the St John Ambulance Brigade, Lt-Gen Sir Otto Lund was guest of honour at the 138 BTH (Willesden) Division's annual dinner.

Assoc. of Electrical Machinery Trades have become affiliated to London Chamber of Commerce. Their representative will be Mr G. H. Holding of Stewart Thomson and Sons (Liverpool) Ltd., Dacre Hse, Victoria St, Westminster.

Colleagues of Mr Leslie Wall, who at the time of his death last September was Birmingham sales manager of Electrical Components Ltd., have set up The Leslie Wall Memorial Fund. To date they have collected £220 as a donation to the E.I.B.A.

Telcon's employees have staged another successful Christmas bazaar raising a record sum of £180 in aid of Queen Mary's (Roehampton) Hospital.

## New Long Service Assoc.

A NOTABLE addition to the Ediswan Organisation's group of Long Service Associations is the new London branch. Formed comparatively recently, this new branch held its first annual dinner recently at the Horse Shoe Hotel. In proposing the toast of the Association at this function, Mr J. R. Cheetham, export department manager, said the new branch completed the circle of Long Service Associations throughout the Organisation. The gathering of 75 members from London and the provinces, including several lady members, represented about 50% membership of the London branch.

## *Sayings* OF THE WEEK

*"In Britain we have more knowledge of the application of atomic power for peaceful purposes than any other country in the world..."* SIR STEPHEN HOLMES, British High Commissioner in Australia, stated at Sydney.

*"Two British housewives yesterday agreed that cooking for Americans is easy—in a kitchen where a tin-opener wears out in a week..."* report in the *Daily Express.*

*"It seems to me high time that the (lamp) bulb makers designed a bulb which would live out its allotted span in whatever position it was used..."* AMANDA NEAL writing in the *Welwyn Times.*

# *QUESTIONS IN PARLIAMENT*

### Registering Traders

COMPULSION on traders to keep new records of transactions in connection with purchase tax was questioned in the House last week. Reference was made to notice No. 77 H issued by the Customs and Excise, and the Financial Secretary to the Treasury was asked if he felt that this requirement to keep new records of transactions between two traders one of whom was already registered for purchase tax purposes was morally sound. In reply, the Financial Secretary said that the new plan was evolved to make it possible to extend the system of registration for purchase tax purposes, which was generally desired amongst traders themselves.

Latest position as regards registration was exclusively reported in our 18 Nov. issue.

### P.T.—No Statement . . .

IT was stated last week that it was not yet possible to make an announcement concerning changes in purchase tax in the coming year. The Chancellor of the Exchequer was said to be aware of possible disturbance to the trade that announcements may cause.

### . . . and Problem of Stocks

THE question of traders' stocks when purchase tax was reduced was raised again last week. Mr H. Brooke, Financial Secretary to the Treasury, said the subject had been considered carefully, but all proposals so far seen were subject to the objections voiced in the Report of the Hutton Committee. For that reason it had not been possible to accept them. However, his mind was not closed on the subject and all further suggestions would be considered.

### Atomic Waste Disposal

MINISTER of Housing and Local Govt. stated last week that he did not feel that consultation with local authorities in the case of the proposal to dispose of atomic waste in the Forest of Dean had been sufficient.

### Signs outside Hotels

APPEALS against rulings concerning the use of illuminated outdoor signs by hotels were mentioned in a question last week. It was suggested to the Minister of Housing and Local Govt., Mr Sandys, that existing regulations should be amended so that the need for hotels to have adequate illuminated outdoor signs should be recognised.

### Smog Report being considered

IN reply to questions about the Government's intentions with regard to the Beaver Committee's recommendations on air pollution, Mr Sandys said that the report was still being considered. He emphasised the need for close study of the report before legislation was proposed.

During discussion on the Business of the House on Thursday, Mr G. Nabarro asked if time could be given to a debate on the Beaver Report on Air Pollution. Mr H. Crookshank could not agree to the suggestion, pointing out that the recommendations contained in the report were being considered and a statement would be made in due course.

### Pollution by Motor Vehicles

MOTOR vehicle exhausts was the subject raised by Mr N. Dodds last week. He asked the Minister of Transport whether the suggestions made in the Beaver Committee's Report on Air Pollution as regards motor vehicles were being con-

sidered. The Minister said the law on motor vehicle exhausts was adequate and the matter was now one of enforcement by the police. He had sought the co-operation of the principal associations of users of diesel-engined vehicles to avoid smoking exhausts, and they had promised their full support.

### T.V. Suppressors

REGULATIONS concerning the fitting of television suppressors to electrical appliances would probably be laid before Parliament early in the New Year, Mr D. Gammans stated in a written answer last week.

### Schools' Fuel Consumption

THE Minister of Education said he hoped to let local education authorities have some preliminary findings on the subject of fuel consumption in post-war schools, in two or three months' time.

### Sandwich Courses

AN earlier request to the National Advisory Council on Education for Industry to investigate the need for sandwich course among certain blocks of industry was recalled by Mr M. MacPherson, who asked if any further progress was known. Sir David Eccles said the matter was still being investigated and he had received no recommendations yet.

### Embargo an Encouragement

IT WAS suggested by Mr S. T. Swingler that the embargo on some standard types of scientific instruments damaged our export trade because it encouraged Eastern European countries to manufacture for themselves. Mr P. Thorneycroft said the question had been considered and said that some items on the embargo list were being made in the Soviet bloc, but that was not a conclusive argument for removing them from the embargo list.

### Weights and Measures

THE House was assured that work was proceeding as quickly as possible on the question of revised legislation concerning Weights and Measures. Mr P. Thorneycroft said, however, he was unable to say when new legislation would be introduced.

### Telephone Cable Damage

SOME details of damage to telephone plant by recent severe and prolonged gales were given in a written answer by Mr D. Gammans. He said that in Wales and S. Western England about 35,000 subscribers' lines were affected and about 200 small exchanges isolated for short periods. About 1,300 subscribers and 18 exchanges were similarly affected in Pembrokeshire, and damage was done to cables carrying junction and trunk circuits. Repair work had been carried out quickly and conditions were expected to be back to normal in a day or two. Replying to Mr D. L. Donnelly, he said many other areas suffered similarly and it was not possible to draft in staff.

# ELECTRIC SUPPLY NEWS

### Bangor (N. Wales)

Protests at the erection of o.h. lines in the vicinity of houses, particularly near aluminium bungalows in Bloomfield Place, were made at the recent meeting of the Borough Council. Ald Porter said that the Council had forwarded their objections to the Electricity Board after a fatal accident at Enniskillen. They now used a "rubber stamp" when giving permission for erection of overhead cables, and stated that they did so with the greatest reluctance and under protest. That arrangement could not continue indefinitely, he declared. The surveyor, Mr J. W. Coskerry, pointed out that the cables at Bloomfield Place were some distance beyond the gardens of the bungalows. It was decided to ask the P.M.G. to investigate the matter.

*The Lord Mayor of Manchester switches on the new substation*

### Blyth

The B.E.A. is applying for leave to introduce in the present session of Parliament a Bill entitled "Blyth Generating station (Ancillary Powers)" to give the Authority power to carry out certain civil work in connection with the establishment of the proposed Blyth power station. The Bill states that the B.E.A. are proposing to build two generating stations in the urban district of Bedlingtonshire, which together will be known as the Blyth generating station. The most convenient and economical method of discharging ash and water from the station is to discharge them into the sea. The Bill would enable the Authority to acquire lands and easements for the purpose of constructing works necessary for the discharge of this ash and water from the station. The work would include a line of pipes, an aqueduct and a single line railway.

### Eire

Work has started near Ferbane, Offaly, on the erection of the power station buildings and on the site development, including foundations for the peat handling equipment. This new station will be the largest of the peat-fired power stations built or planned by the Electricity Supply Board. In the first development the station will be equipped with three 20,000 kW steam turbo-generating sets and three boilers with an output of 220,000 lb of steam an hour. Two cooling towers, each 266 feet high and 185 feet in diameter, are under construcion. This stage is to be completed in two or three years and will have an output approximately of 240 million units a year. For the final development two further turbo-generators and two additional boilers will be required.

### Manchester

On Tuesday of last week, the Lord Mayor of Manchester, Alderman R. S. Harper, officially switched on the 1,000th substation in the No. 1 sub-area of the North Western Electricity Board. The new substation is constructed in a cellar below Albert Square and is one of a ring of substations which form part of a reinforcement scheme, the need for which is related both to the steady increase in the demand for electricity in the heart of commercial Manchester and to the development of smokeless zones. The density of load at the present time in the centre of Manchester is greater than anywhere else in the country, with the possible exception of the City of London.

## LIGHTING SCHEMES

**Bangor (N. Wales).** The Council has approved schemes for improved lighting in Hamilton Rd and Abbey St at a cost of £3,249.

**Brighouse.** Scheme prepared for the erection of 61 lamps to provide class "A" lighting on the Leeds-Whitehall Rd, estimated to cost £3,731.

**Colne (Lancs).** Borough engineer to prepare schemes for conversion to electricity of gas lighting in West St, Colne Lane and Waterside Rd.

**Nelson.** T.C. is making application to borrow £23,200 for providing electric lighting on certain traffic routes in the borough. This is the first stage of the conversion of gas lighting, the total cost of which is estimated at £83,402.

**Newbury.** T.C. is submitting to M.o.T. £7,000 scheme for providing group "A" lighting in the London Rd.

# COMPANY ACTIVITIES

THE annual speech by Sir Alexander Aikman, chairman of Electric and Musical Industries, confirms our previous ideas that the group has made important strides towards complete recovery after the disappointing results of 1952/53. Plans laid back in the doldrum period are beginning to bear fruit. In the year to 30 June last, U.K. turnover rose by 20% and exports went up by nearly 23%. Overseas subsidiaries sold 24% more. And these satisfactory results are gilded by the fact that they were obtained in a period when price levels remained reasonably stable.

Mr F. G. Penny, chairman of Aberdare Cables (Holdings), does well to bring South Wales Switchgear and Aberdare Engineering fully under the control of Aberdare Cables (Holdings) Ltd., the parent concern. For every three of the 599,996 5s. shares in South Wales Switchgear not already held, Aberdare Cables offers four of its 5s. shares. Accepting shareholders of Aberdare Engineering will receive ten Aberdare Cables shares for every three £1 shares now held. But some shareholders may hold back because the new shares do not rank for any further dividend which may be declared in respect of the financial year ended 31 Oct. last.

I.S.T. Insulations is to become a public company. Whitehead Industrial Trust is placing 1,700,000 1s. Ordinary shares on the market. This is the whole of the equity capital. I.S.T. specialises in electrical insulating materials sold exclusively to the trade. The directors expect that net profit for the year to Mar. 31 next will not be less than the £36,400, subject to tax, of the previous year. Dividend is anticipated at 15% from Dec. 8, the date of the acquisition by the present company of the shares of Insulated Sleevings and Tapes, to 31 Mar. A full year's 15% dividend would be covered twice over. The Ordinary shares are being placed at 1s. 1½d., free of all charges.

Radio and Television Trust, formerly Philco Radio and Television Corpn., is wise to dispose of Britannic Cable Co., one of its two operating subsidiaries. There is much competition in the cable business and the decision to concentrate on electronic instruments and apparatus through Airmec Laboratories Ltd., is probably best calculated to revive the company's fortunes. An offer for Britannic of £425,440 has been formally accepted by the board. The bank want the overdraft reduced and if they take the money received for Britannic Cable, overdraft will be down to about £75,000 and interest in subsidiaries to £233,539 against £474,894. Debit balance carried forward last time of £743,000 would look a bit better at £560,000. Next step would be capital reconstruction to pave the way for paying off Preference dividend arrears and sinking fund certificates' interest. The board anticipate that a drastic reduction in capital will be essential, which is fairly obvious as the Ordinary capital is only £150,000. Last dividend was 25% for 1947-48.—*From our City Correspondent.*

### Aberdare Cables (Holdings) Ltd.

It is revealed that the board have offered to buy out the minority shareholders in South Wales Switchgear Ltd., (amounting to 599,996 5s. shares) and 134,700 of the 200,000 £1 shares in Aberdare Engineering Ltd. For every three of the former, Aberdare Cables Ltd. offer four of its 5s. shares, while holders of Aberdare Engineering Shares are offered 10 for every three £1 shares now held. The new shares in Aberdare Cables Ltd., will not rank for any further dividend which may be declared in respect of its financial year ended 31 Oct.

### Bruce Peebles and Co.

An extraordinary meeting is to be held on 29 Dec. to consider the proposals to increase the authorised capital to £500,000 and the one-for-one scrip issue to shareholders, noted on 25 Nov.

### Drayton Regulator Co. (Holdings)

A two-for-one scrip issue is announced.

### Electric Furnace Co. Ltd.

It is proposed to make a bonus issue of 33,313 5½% Cumulative Preference shares of £1 each to Preference shareholders, and to convert the existing 7½% Cumulative Preference into 5½% Cumulative Preference of £1 each. It is also proposed to make a bonus issue of 156,500 Ordinary £1 shares to Ordinary holders on a one-for-one basis.

### General Cable Manufacturing Co.

The reduction in trading profit for the past year can be considered not entirely unexpected in view of the cold winds that have blown in sections of the cable industry during the period. This company, however, is well situated financially, with current assets at 30 Sept. last being listed at £476,196, while current liabilities only amounted to £91,782 plus £500 for capital commitments. The value of stock in trade and sundry stocks, at £221,602, was nearly £33,000 higher than a year ago. It is revealed that the company has offered Radio and Television Trust Ltd. £425,440 for its holding in Britannic Electric Cable and Construction Co. (another "non-ring" firm).

| Year to/ 30 Sept. | £ Trading Profit | £ Net Profit | % on Ord. Earned | % on Ord. Paid | Ord. Price High | Ord. Price Low |
|---|---|---|---|---|---|---|
| 1951 | 120,473 | 46,715 | 67 | 30 | 18/9 | 16/6 |
| 1952 | 146,077 | 54,120 | 70 | 30 | 16/10 | 11/10 |
| 1953 | 119,321 | 45,078 | 53 | 30 | 17/- | 14/9 |
| 1954 | 99,187 | 36,037 | 41 | 30 | 18/- | 16/- |

### I.S.T. Insulations Ltd.

A total of 1,700,000 1s. Ordinary shares in this firm of specialists in electrical insulating materials for the trade, are being placed by Whitehead Industrial Trust. This is the whole of the equity capital which follows £9,000 in 6% Preference. The directors expect that net profit for the year to 31 Mar. next will not be less than the £36,400 of the previous year.

### Oliver Pell Control Ltd.

For the year ended 31 Mar. last, the trading profit dropped to £11,831 compared with £34,733 for the previous year. The net profit figure is £548 (£20,012).

### Peto Scott Electrical Instruments Ltd.

For the year to 30 June last the profit is £16,947 compared with a loss of £57,663 for the previous period. The first figure is struck before crediting fire damage and loss of profits insurance claim of £15,332 (*33,914*). There is £44,337 written off in respect of stock and work, and the net loss is £30,882 compared with a net loss of £38,364 a year ago. The directors also state that proposals for capital reduction and reorganisation will be submitted following the annual meeting.

### Radio and Television Trust Ltd.

The board has formally accepted an offer of £425,440 from the General Cable Manufacturing Co. for its holding in the Britannic Electric Cable and Construction Co., one of its two operating subsidiaries. The agreement needs approval of the Trust's stockholders. The board explains that at the end of March last, the Trust's bank overdraft was £544,403, but that total has since been reduced to approximately £500,000 as a result of a dividend from Airmec, the other principal subsidiary. The bank wish to see a substantial reduction in that overdraft, and if the sale of Britannic Cable Co. is approved the Trust's balance sheet would show a reduction in interests in subsidiaries from £474,894 to £233,539, an overdraft of about £75,000, and an adverse balance on profit and loss account of some £560,000. Until this adverse balance is dealt with by a capital reconstruction, it is added, there is no way of paying off any of the arrears of dividend on the Preference stock and Sinking Fund certificates, or of paying current dividends. The board are endeavouring to devise a capital reconstruction scheme, but a drastic reduction of capital will be essential.

### Dividends Declared

*British Insulated Callender's Cables.* Interim of 2½% (*same*).

*Broadcast Relay Services.* Interim of 10% tax free (*same*) on capital increased by 10% rights issue.

*Max Stone.* Interim of 30% (*20%*).

*Vent-Axia Ltd.* Interim of 30% (*25%*). Profits before tax, and unaudited, for the six months to 30 Sept. last is £63,700 (*£52,700*) it is stated.

INDUSTRIAL MAINTENANCE

*A special monthly section of the Electrical Times*

# *The Economics of* Power Factor Correction

By R. Solt, B.Sc., A.M.I.E.E., A.M.I.Mech.E.

POWER factor correction has formed the subject of many papers and articles in the past. Most of these have concentrated on particular aspects of the field: the present paper attempts to present an unbiased general survey of the subject. To the generating and supply undertaking, low power factor presents the problem of extra demand; the cost involved is handed on to the consumer in the form of a power factor tariff. Different kinds of power factor correcting equipment are available, and the consumer's decision whether and how much gear should be installed depends more obviously on the economic advantage to be gained than do most other engineering decisions.

Power factor is defined as the ratio of true power to apparent power, i.e. watts to volt-amperes. In an a.c. circuit the ratio is less than unity if the current and voltage waves are out of phase with respect to time; there is then a vector displacement between current and voltage, and the current may be split into the power component in phase with the voltage, and the reactive component in quadrature. The total kVA input into the system is similarly split into the power (kW), and the reactive kVA (kVAr); the excess of kVA over kW is referred to as "extra kVA."

The calculation of the quantities involved is a matter of simple trigonometry. Mechanical calculators (such as Mulligan's power factor calculator) may be found useful.[1]

### *The Cost of Bad Power Factor*[2]

Transformers, reactors, transmission lines and other items of electrical plant contribute to the bad power factor of a system; the major portion of reactive kVA, however, is drawn by induction motors installed at consumers' premises. This extra kVA is therefore transmitted over the whole of the distribution system whose various components must accordingly be designed with an adequate margin of electrical carrying capacity. Thus, if a system operating at 0·8 power factor were corrected to unity, this would increase the power carrying capacity by one quarter.

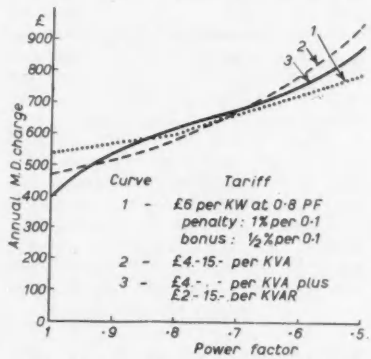



*Fig. 1. Maximum demand charge on 100 kW with various types of tariff**

Apart from greater first cost, a bad power factor brings with it increased running charges: there are higher resistance losses, and heavier voltage regulation throughout the system. It has been estimated that the cost of an extra kVA is of the order of two-thirds of the cost of a kW; whilst an extra kVA-hour costs somewhere between one-sixth and one-third as much as a kWh.

The additional expense to the generating and supply undertakings is handed on to the consumer.[3] The types of tariff which take account of power factor, combine a unit consumption charge with one of the following:

(i) A fixed charge per kVA of maximum demand.

(ii) A fixed charge per kW of maximum demand, with a percentage bonus or penalty, graded according to power factor and affecting either the fixed or both parts of the tariff.

(iii) A fixed charge per kW, and a fixed charge per kVAr, of maximum demand.

The first two of these methods occur in a profusion of variations. On nationalisation, one sub-area alone took over upwards of 60 different power tariffs from the various local undertakings. During the past years several standard tariffs have been evolved in different areas. Some of these tariffs are of the kVA maximum demand type, some of the bonus/penalty type. They operate with consumers whose demand justifies the installation of the necessary metering equipment. Here again different rulings apply in different areas of the B.E.A.: in one area consumers with a maximum demand exceeding 75 kVA are charged on a power factor tariff, whilst in another any consumer with a demand as small as 5 kVA may choose to be charged on a power factor basis.

Of the different types of tariffs, the kVA demand tariff is the simplest but the most rigid. There is an increasingly greater incentive for the consumer to correct his power factor the worse it is. The bonus/penalty tariff is more flexible since the power factor datum as well as the per-

* *The prices used in the curves illustrating this article are not, in general, current prices but apply to a few years back.*

centage surcharge or rebate can be varied. The conception of a bonus or penalty is a psychological inducement for the consumer to install correcting equipment.

The third type, the kW and kVAr tariff, would be simple to understand and easy to meter. Although recommended by some, it is rarely met with in practice. One objection may be, that it would pay the consumer to correct his power factor right up to unity; but this could easily be avoided, by only charging for reactive kVA in excess of 33% (say) of the kW demand: this would limit the kVAr charge to power factors lower than 0·95 approximately.

In most cases, tariff charges make up the greater part of the cost to the consumer; though if his internal distribution network is extensive, voltage regulation and distribution losses may become sizeable factors. Where the consumer generates his own power it may pay him to compensate for reactive if his generating or transmission capacity threatens to become overloaded with extra kVA.

### *Avoiding Bad Power Factors*

The optimum power factor of a machine, a system or an installation is primarily governed by cost. Within limits, greater initial expenditure on materials or apparatus will result in certain savings on the subsequent running costs; the economically most desirable condition brings with it least overall cost, taking into account the total overall expenditure—i.e. including both first cost and running cost.

Consider now the induction motor, which has been mentioned as the main source of low power factor in industry: its reactive component depends largely on the reluctance of the magnetic path. Since such motors are usually designed to run near saturation (near the bend in the magnetisation curve), a small decrease in voltage will result in a relatively great decrease in the magnetising current.*

A considerable saving on running costs can often be brought about by running a machine at a smaller flux density, as a result of building it with more iron in the core in the first place. The additional cost of building a larger machine may result in savings many times as great. Depending on tariff and operating conditions, the extra cost involved in building a typical 10 h.p. induction motor with a higher inherent power factor may produce savings between five times and a hundred times as great.

Just as the intending buyer of a large power transformer specifies the operating conditions in order to obtain the most economical design, so also can the running cost of a motor be taken into account by an intending purchaser. This is actually done by a few large organisations dealing with extensive power installations, such as the G.P.O., but the practice is not followed as widely as it might be: it is often not appreciated that the annual power charges of a motor may be several times as great as its first cost.

Authorities on engineering economics sometimes suggest the adoption of two standard ranges of motors, one cheaper and less efficient, and the other more expensive but with smaller running costs. It does not however follow that the intending buyer would choose the better machine even if this were to prove more economical in the long run. This would be the case only if his capital resources were unrestricted.

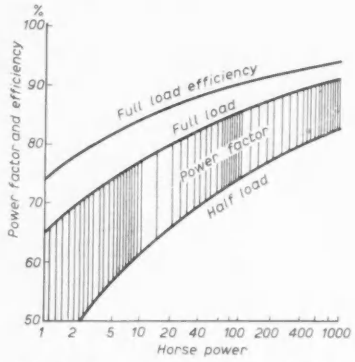



*Fig. 2. Approximate efficiency and power factor curves for induction motors of varying horse powers*

In effect, the standards to which machines are designed are dictated largely by common practice and by competition. In the absence of an expressed consumer demand for higher efficiencies and better power factors, the manufacturer has to strike a compromise between performance and competitive cost. Perhaps the first step in bringing about such a demand would be to make the large mass of consumers more conscious of the cost of running their machines, a cost which is incurred when buying the motor.

Industrial installations too frequently employ electric motors whose rating is much in excess of power requirements; this is perhaps the greatest single factor responsible for the low power factor of so many installations. The full load power factor of a medium or large induction motor is reasonably high; but its value deteriorates increasingly as the load is decreased. R. B. Giles, in a paper several years ago[4] quoted figures of peak currents and average currents obtained with different motors installed in a mass production machine shop. The twelve motors tested represented a total installed capacity of 134·4 h.p. From the figures given, the power factor with all motors running at average load has been estimated at 0·51; the power factor at the time of maximum demand is probably of the same order.

If motors had been installed to satisfy no more than the peak demand on each machine, the installed capacity could have been reduced to about 85 h.p., with a power factor of approximately 0·68. The saving on first cost, due to the smaller installation, would have been about £140; but the annual saving on maximum demand charges is estimated at £200 (with a £6. 10s. demand charge per kVA). There may in addition be a saving on consumption charges, as the full load efficiency of the smaller machines is probably higher than the fractional load efficiency of the over-powered machines.

Over-powering is often found with machine tools; makers tend to supply a motor which can meet the maximum load their machine is able to carry, and without reference to the only very light operation it may actually be expected to perform. This practice is most wasteful, and not only raises the first cost unnecessarily, but imposes a heavy penalty on the user every year thereafter.

### *Power Factor Correction* [5, 6]

As already stated, optimum power factor brings with it lowest overall cost, taking into account both initial and subsequent expenditure. When installing compensating plant or high power factor machines, the initial capital expenditure involved will result in savings on the recurring running charges.

In order to find the optimum power factor, we compare the cost of improving the power factor with the saving that is brought about. Obviously, a basis for comparison only exists if "costs" and "savings" are reckoned over the same period of time, usually a year. With an industrial consumer, the savings anyway —in the majority of cases—consist in an annual reduction in the electricity bill. Costs may include annual running costs such as power, attendance, and maintenance; the major item however is usually provided by the yearly portion of the first cost of the equipment (or, in the case of a high power factor machine, the corresponding portion of the extra cost compared with the cost of an ordinary induction motor of the same output). With large plant and equipment, which has a high first cost and is written off over a great number of years—namely its expected period of life—this amount should be determined as the annual payment into a sinking fund. Alternatively, straight line depreciation over the same or a shorter period can provide an acceptable working basis; other methods are also available but are rarely used.

The question of optimum power factor can be tackled mathematically.

Suppose that both the extra expenditure and the resulting savings may be expressed as functions of the same variable "x" (namely power factor, or kVAr). If the expenditure varies as F(x), and savings as f(x), then the net saving is given by their difference: f(x)−F(x).

For maximum net saving—or minimum overall cost—the differential of the expression is zero, and

$$\frac{d}{dx} f(x) = \frac{d}{dx} F(x)$$

i.e. the rate of change of the two functions must be equal. As successive amounts of money are spent to improve the power factor, the saving df resulting from each successive amount dF be-

* The extent of this reduction must ultimately be limited by the resulting reduction in the motor overload capacity.

comes smaller and smaller, until the last unit dF spent on the machine produces a saving df smaller than dF. This is in accordance with the economic law of diminishing returns; the economic limit is reached when the marginal cost just balances the marginal return, where the marginal quantity refers to the last unit added to an existing amount.

The above remarks apply equally to the initial design of a machine (a more expensive motor will, within limits, be cheaper to run), and to the subsequent installation of compensating gear. In the latter case, the factors involved are usually known quantities and the economic limit may be determined mathematically.

If P denotes the power demand in kW
$\phi_1$ and $\phi_2$ the power factor angle before and after correction
A the annual tariff charge per kVA demand, in £
B the annual cost of compensating equipment, in £ per kVAr;

Then a cost of $BP(\tan\phi_2-\tan\phi_1)$ produces a saving $AP(\sec\phi_2-\sec\phi_1)$. For maximum net saving, the difference of cost and saving is differentiated and equated to zero:

$$AP\sin\phi_2\sec^2\phi_2=BP\sec^2\phi_2$$
$$\sin\phi_2=B/A$$
$$\cos\phi_2=\sqrt{1-(B/A)^2}$$

If the equipment is written off over a greater number of years, the annual cost B is reduced; the optimum power factor to which it will pay to correct is then higher than in the case of a short term installation.

What has been given so far is a theoretical approach to the problem of how much power factor correcting equipment should be installed under any set of specified conditions. This method is not usually applied to an average factory installation as the amounts involved are not sufficiently great to warrant lengthy calculations; in any case, the data are usually subject to heavy variations* and results to a high degree of accuracy are therefore meaningless.

Instead, some figure—usually 0·95 or 0·96—is stipulated as a desirable plant power factor, and this is then aimed at in calculating the amount of equipment needed. The method of approach is thus reversed, and having determined the first cost of this equipment and the annual savings it will produce, one finds the number of years required to recover the initial outlay. Any reduction in the electricity bill after that time will then represent pure savings. To the short-term manufacturer this is obviously the most appealing form in which the advantages of power factor correction can be presented; especially as it is quite usual for the outlay on an installation costing a few hundred pounds to be recovered within one, or at the most two years.

This fact has a wider implication: what is a small-scale saving to individual consumers, adds up to represent a saving of the "capital" and resources of the country (i.e. of plant, manpower, and fuel). Once the necessary compensating equipment had been produced and installed, one could put to useful work the additional capital now spent year by year on generating and transmitting useless extra kVA.

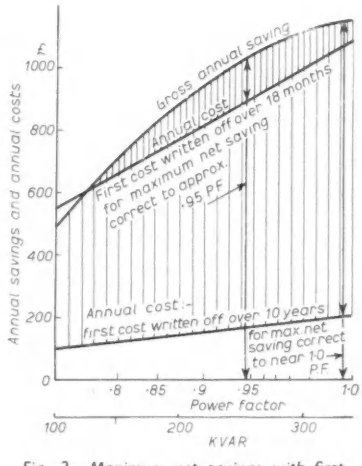



*Fig. 3. Maximum net savings with first cost written off over different periods of time. Curves are drawn for 250 kW m.d. and a tariff of £6. 10s. per kVA*

### *Synchronous Machines*

The synchronous condenser[7,8] is given first place merely as the classical example of power factor correction machinery. In industrial practice, it has been largely ousted by the capacitor, and its field of application is in any case limited to those large plants which do not offer the possibility of running a synchronous machine over-excited. In steel mills, for instance, mill motors must be given a drooping speed characteristic, and synchronous machines cannot be used. One steel works, however, installed a 300 kVA synchronous condenser a few years ago.

Whereas the first cost of a synchronous condenser is relatively low (though the cost may be greatly increased, if an auto-transformer is needed to keep the starting kVA within prescribed limits), the running losses are perhaps ten times as great as those of a comparable capacitor bank; in addition there is the greater attendance and maintenance required.

In the larger sizes, the synchronous condenser finds its application on distribution networks with long transmission lines, when it is installed at or near the load centre. More usually, synchronous condensers are installed on power networks for the purpose of voltage regulation. The machine must then be designed to provide either leading or lagging kVA without losing stability.

Synchronous motors are salient pole machines which may be run over-excited and hence at a leading power factor. Their major disadvantage lies in the low starting torque obtainable without drawing an excessive starting kVA. The motor may be induction-started by means of pole face windings or by means of solid poles, according to whether a relatively higher synchronising torque or a higher starting torque is aimed at. A separate slip-ring winding on the rotor, used with a starting resistance, will improve the starting performance but tends to render the machine less efficient. Otherwise, the efficiency is of the order of that obtained with a slip-ring induction motor, or up to about 1% higher. The machine finds its application in drives for fans, pumps and motor generator sets, where the starting duty is light. Within its kVA rating, it may be run at any power factor without becoming unstable.

The synchronous induction motor has a cylindrical rotor with a three-phase winding brought out to slip-rings. The machine is resistance-started like an ordinary slip-ring induction motor, and when the rotor speed approaches synchronism a d.c. potential applied to the slip-rings pulls the machine into step. The arrangement is capable of giving up to twice full load starting torque with about 120% of full load kVA. The overload capacity of the machine is determined by the normal full load power factor, and by the magnetising current of the motor. In order to raise the synchronous overload capacity, the rotor must constantly carry a large amount of exciting current. †The efficiency of a synchronous induction motor therefore tends to be lower than that of an ordinary induction motor. Overloaded to beyond the synchronous torque, the motor does not stall like the pure synchronous machine; and when the load is reduced, the machine once more pulls into step.

The necessity for continuous over-excitation can be avoided by automatic field control; an efficient means of obtaining this is with the patented VAX (Variable Automatic Excitation) system which gives a smooth and instantaneous response to load variations.[9] Series transformers in the primary motor circuit energise an auxiliary field winding on the exciter. The exciter fields can be compounded to produce more, less, or constant kVAr at the main motor terminals as the load varies; overloads of up to 200% can be catered for without impairing the normal full load efficiency. Since the magnetising current need not now be artificially raised, the efficiency is improved; also, the same starting kVA will produce a much higher starting torque. This arrangement is not suitable for running at low leading power factors, where the hysteresis effect of the rotor core may give rise to power factor instability. It has found its application where variable load constant speed drives are required; in conjunction with a

* There may, for instance, be a heavy seasonal variation, if additional lighting or electric heating during the winter months improves the power factor. Even without this, few installations work under identical conditions for long periods.

† The field is stiffened by lengthening the air gap which increases the magnetising current: an overload capacity of 60% requires a rotor current permanently 75% in excess of that required for full load in an induction motor of the same capacity.

hydraulic coupling it is used to drive flywheel Ward-Leonard sets. Sizes range from a few hundred h.p. upwards.

### *Asynchronous Machines*

Twenty years ago, Professor Miles Walker, the champion of the phase advancer,[10,11] demonstrated that the first cost of a combined induction motor and phase advancer need not exceed that of the simple induction motor. He envisaged phase advancers for use with induction motors down to 50 h.p. as an economic proposition. Subsequent events did not follow this expectation. Though a great many different types of phase advancers were evolved, they are only rarely used nowadays; but a fair number are doubtless still in operation.

A phase advancer may be fitted to an existing slip-ring motor if the brush gear is sufficiently heavy; if required to overcompensate, the motor may have to be de-rated to avoid overheating the rotor. When a phase advancer is applied to an existing machine there may be an overall reduction in efficiency of up to 2%; whilst if the two units have been designed for use together, there should be a slight improvement in efficiency.

Phase advancers are unpopular because of the high maintenance required. Most types take the full secondary current of the main motor, and commutation tends to be difficult. There seems to be a great deal of prejudice against a.c. commutator machines in general.

Compensated machines are similar to the Schrage variable speed motor: if this is run unidirectionally, the centre axis of the two sets of brush arms may be shifted off neutral in order to obtain a leading component and thus improve the power factor. In compensated machines, the single set of fixed brush arms is given a permanent lead on the commutator. Two similar machines of this type are marketed under the trade names "Kosfi" and "Nolag." Compared with a straight induction motor plus capacitor, the compensated machine has a lower first cost at ratings of 100 h.p. upwards for fast moving machines. The first cost and also maintenance of slow running machines of this type is higher due to the additional poles and brush gear required. If a commutator motor is run over-compensated, a larger frame size is needed for the same output: but it can then easily correct the power factor of a second machine, and that of a third if there is some diversity.

### *Capacitors* [12]

In low and medium power installations the static capacitor has now completely ousted the synchronous condenser[13]. Its cost relative to rotating plant has become progressively smaller over the past years, and its running losses are extremely low: one firm guarantees not to exceed 1·3 watts per kVA installed. Static capacitors are simple to install, and an arrangement of capacitor banks is therefore highly flexible and mobile. They require periodic inspection rather than maintenance, and they are completely reliable; a set of records taken some ten years ago showed that of 5,600 15 kVA units installed, and used over 125,000 kVA-years, only 25 units broke down.[14] Where no single motor in a factory exceeds about 75 h.p., and the total demand is only some 600 to 700 kVA, power factor correction can almost invariably be carried out best by static capacitors.

There are three methods of installing capacitors:

(i) by individual connection to each motor:

(ii) in groups distributed about the internal supply system:

(iii) by block connection at or near the point of supply.

With individual connection [15,16] both the motor and the capacitor are controlled by the same switch, so that the capacitor is always automatically brought into service when required. The reactive is compensated at its source, and sometimes the size of the supply cable can be reduced (e.g. in particular in mine installations, where individual motors may have long feeders). The size of capacitor which can safely be connected to an induction motor, however, is limited. If it is too large, the set may become self-excited when disconnected from the supply and act as an induction generator with a dangerously high output voltage. This can occur when the set is driving a high inertia load which will continue to turn the motor after power has been cut off.

If an excessively large capacitor is connected to an induction motor with star-delta starting, the self-excited voltage is liable to fall out of step with the mains voltage during the short time of disconnection when switching from the starting to the running position. The effect is the same as closing an alternator on to the busbars without synchronising, and the machine tends to pull momentarily into step. If again a high inertia load is being driven, the shaft may be subjected to a high transient torque. It will normally be found safe to connect sufficient capacitance to the motor terminals to raise the full load power factor to somewhere short of unity; (according to the B.S. Code of Practice, CP 312.102 (1950), Clause 319, the capacitor current should not be greater than 85% of the motor magnetising current). It is therefore never permissible to over-compensate an individual machine by means of a capacitor.

Individual compensation is of advantage where fair-sized motors are installed, and if their diversity is low. With small machines, the cost per kVA of the smaller capacitor unit is much greater, and if capacitors are to be added to existing motors the installation costs become disproportionately high. In such cases it rarely pays to compensate individually with motors of less than about 10 h.p. If the motor diversity is great, the total capacity required for individual connection is much higher than with group connection.

Consideration of group connection raises the question of control, as capacitors must always be taken out of circuit when not required. Some method of automatic control should normally be recommended.[17] The loss arising from a single omission to switch on the capacitors when they are needed is too great to justify risking this with manual control.

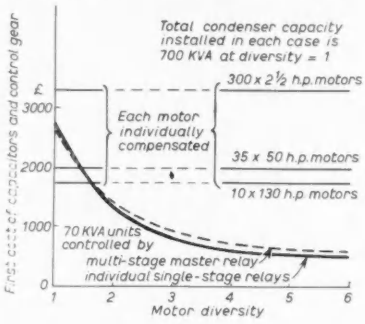



*Fig. 4. First cost of capacitor installations under various conditions (1950 prices)*

If any particular motor is always running when the plant is in operation, a current transformer in its supply lead may establish a closing circuit for the capacitor contactors. Alternatively a reactive-sensitive induction relay can be arranged to operate a series of switches which bring in successive capacitor units as they are required. The cost of such relays and the necessary contactors may be a large proportion of the total installation cost; thus a bank of ten 50 kVA capacitors, costing about £1,650—would require control gear to the extent of about £900 (one 10 stage "NJ" Relay and cubicle, plus contactors). The cost of cables and installation would be additional.

Finally there is block connection, usually applicable in small or compact works, where the saving on internal feeders would be small even with individual compensation. Some method of control is again required. In some cases this would enable a capacitor to be installed on the high voltage side of a supply transformer, and this may make for a smaller and cheaper capacitor unit.

### *General Considerations*

It is evident that economic considerations must always be subject to practicability. This is the case when any large machine is required to have certain mechanical characteristics which will determine the type of motor to be used. Where different types will serve equally well the choice will be based on all the usual considerations:—first cost, running cost, delivery dates, etc., as well as suitability for power factor improvement.

In the case of a new installation which includes constant speed motors of 100 h.p. and upwards, it normally pays to provide phase-compensated machines rather than induction motors with capacitors, which require a much greater installed capacity. Thus a 200 h.p. machine, compensated to run at a power factor

of 0·9 leading, takes about 180 kVA; whilst an ordinary induction motor of that rating (and p.f. 0·88 lagging) would take 190 kVA, and require capacitors to the extent of 170 kVA, i.e. a total installed 360 kVA to give the same effect as the 180 kVA compensated machine.

Depending on the characteristics of a system and on the amount of leading kVA to be injected into it, it may sometimes be cheaper to replace a motor in an existing installation by a compensated machine, than to install an independent set of static capacitors. Either of these solutions will be more expensive than the provision of power factor correcting gear would have been when the motors were installed in the first place; and whenever a new installation is planned, the improvement of its power factor should always be one of the considerations. Where economic considerations would favour rotating gear (i.e. phase compensated machines) by only a small margin, the choice may well fall on static gear on the grounds of convenience. If, for instance, the lay-out of a factory may be subject to change, mobility and flexibility of compensating equipment will be of advantage; it is relatively simple to move or to re-arrange a number of capacitor units, rather than a single over-compensated machine whose location is determined by the function it performs.

When correction is carried out mainly in order to reduce tariff charges, reliability is of the utmost importance. A single breakdown of even short duration will usually forfeit the saving on a whole year's electricity bill: but if compensation is achieved by a number of smaller units, failure of one of these will cause a proportionately smaller loss. These and similar considerations—such as the inconvenience of extra maintenance (as opposed to the actual cost of it)—will be taken into account together with the purely economic advantages when different schemes are compared.

### *Summary and Comment*

Having indicated the cost of bad power factor, we have considered the possibility of avoiding excessive kVA by judicious design, and by installing motors of no more than the required capacity. A method of finding the optimum power factor of an installation has been outlined; and the various types of equipment available to give power factor improvement have been mentioned. It now remains to indicate the means by which a general improvement of the power factor level might be achieved. Broadly, three courses are open: (i) legislation; (ii) discriminatory tariffs; (iii) publicity and education.

Legislation might be aimed either at the manufacturer—to the effect that all motors sold must run at or above a specified power factor. All machines would then have to be either compensated or else incorporate a capacitor. The full effect of such a measure would not be felt for many years, until all existing motors have been replaced. Alternatively every consumer could be required to maintain a minimum power factor at his main board. Although appropriate legislation may occasionally seem the solution to many of the supply undertaking's troubles, the introduction of such measures would not be generally welcomed: they are in any case unnecessary.

Application of discriminatory tariffs is the method generally in use, and mention has been made of different types of power factor tariffs. By increasing the power factor charge, greater pressure can be brought to bear on the consumer to install compensating equipment. Too high a power factor tariff could defeat its own ends: consumers would tend to correct up to near unity, whilst a power factor of 0·9 to 0·95 can be carried by the supply undertaking at only very little extra cost.

It is not uncommon for smaller consumers to be unaware of the nature and the cost of power factor. A simple explanation may induce a manufacturer to install equipment to improve his power factor. Some areas of the B.E.A. have established advisory departments whose functions include advice to consumers on ways of dealing with such problems. There is considerable scope for saving power on a national scale by fostering power factor correction, particularly in the small and medium sized works. Now that capital is rapidly becoming less plentiful than it has been for the past years, it might even be of advantage for the supply authority to provide compensating equipment to selected consumers at hire purchase terms, so that the equipment could virtually be paid for out of the savings it produces. On the whole, wider publicity with availability of information and backed up by an incentive tariff should go a long way towards improving the general industrial power factor level.

ACKNOWLEDGMENTS: The author wishes to thank those whose generous advice and information has made the writing of this paper possible. In particular Mr W. B. Best, of Johnson and Phillips, Ltd., Mr C. G. Dobson, of the Telegraph Condenser Co., Mr G. Knights and Mr J. W. Muligan, of Metropolitan-Vickers Electrical Co., Ltd., and Mr A. S. Verity of the B.E.A.

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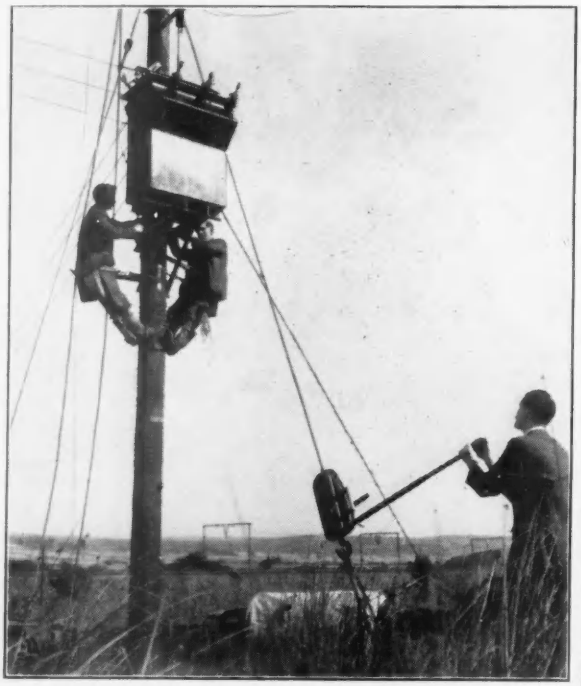

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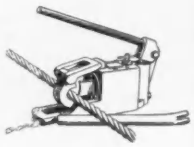

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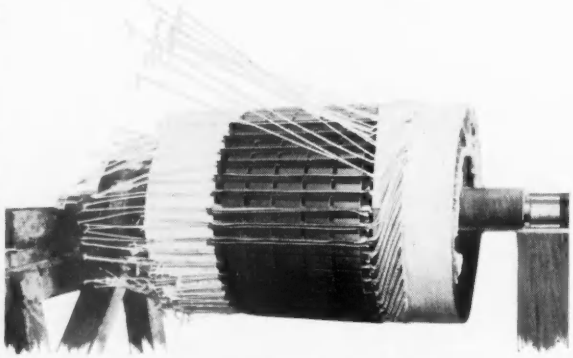

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# *Siemens-Schuckert (G.B.) Type S.12 Circuit-Breaker*

**DATA SHEET 12**

THE S.12 circuit-breaker is designed specifically for the protection of small and medium single-phase, three-phase and d.c. motors and other circuits controlling a current range of 1·5 A—40 A, for motors up to 25 h.p., 3 phase.

The following points are of importance:

1. Bi-metal thermal release for overload current tripping at 100% overload after half a minute or 50% overload after two minutes within the range chosen. (Each range is adjustable ±20%).
2. Instantaneous magnetic short-circuit release, tripping at 8-10 times full load current.
3. No volt release.
4. Core-balance earth trip release, tripping on an earth fault current of 0·75 A; or voltage earth-trip release, tripping on an earth fault potential of 24 V.
5. Each pole of the breaker is fitted with an instantaneous and thermal trip thus giving adequate protection against single-phasing.
6. The breaker cannot be closed until the fault is cleared.
7. Manual resetting.
8. High rupturing capacity.
9. Fuses are unnecessary with this breaker unless the short-circuit current is liable to exceed 3,000 A.

The breaker as illustrated in Fig. 1 is essentially an industrial item and is eminently suitable for machine tools, portable and transportable equipment in mines, quarries, cement works and marshalling yard installations and gives the protection to personnel required by the Mines and Quarries Regulations. The units are supplied singly or can be built up to make a large distribution board (for floor or wall mounting) of any desired size up to a maximum loading of 300 A.

Other advantages claimed by Siemens-Schuckert for their new circuit-breaker include:

1. If a circuit trips owing to an overload or short circuit is can be immediately restored by reclosing the handle instead of replacing fuses.
2. Control of the overload trips can be set more closely than would be the case if the circuit was protected by fuses.
3. Once set, the rating of the overload trip can only be varied within a small range, ±20% of the normal current, so preventing gross interference with the breaker which is always possible when fuses are used.
4. When the breaker trips on core-balance earth leakage it can only be reclosed after the mechanism has been reset by a special key provided. This ensures the safety of the machine tool operators.

The breaker can be supplied: (1) In heavy cast iron box; (2) Steel enclosed; (3) Flameproof.

It should be noted that the unit illustrated includes the core-balance earth leakage trip and has the core-balance transformer in a separate box mounted above the breaker, but the smaller 2-pole breakers are self-contained.

Available Ratings for S.12 Circuit-Breaker

| Rating amps. | Adjustable between (ampers range) | 3 phase motor at 400 V. h.p. |
|---|---|---|
| 2 | 1·6— 2·4 | 1·0 — 1·5 |
| 3 | 2·4— 3·6 | 1·5 — 2·2 |
| 4 | 3·2— 4·8 | 2·0 — 2·8 |
| 6 | 4·8— 7·2 | 2·8 — 4·3 |
| 8 | 6·4— 9·6 | 4·0 — 5·5 |
| 11 | 8·8—13·2 | 5·25— 7·8 |
| 15 | 12·0—18·0 | 7·0 —10·5 |
| 20 | 16·0—25·0 | 9·5 —15·0 |
| 32 | 25·0—40·0 | 15·0 —25·0 |

### *Construction*

The case, particularly robust, is of cast iron and is provided with large rectangular blanking plates on all four sides, to be drilled as required. The breaker cover and all blanking plates are provided with a heavy rubber gland.

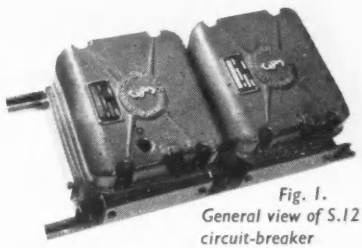


*Fig. 1. General view of S.12 circuit-breaker*

The breaker itself is built on a moulded base M. (Fig. 2). On this is mounted the frame L carrying the contact bar and the trip bar K. The contact bar is operated via a mechanical tripping device which is shown in detail in Fig. 4. On the right of the moulded base is fixed another frame bearing the earth leakage solenoid trip C (Fig. 2). Both the trip bar K and the earth-leakage trip armature (18, Fig. 4) release the mechanism by the small lever (23, Fig. 4) and so opens the breaker. Below the trip bar K can be seen the three sets of instantaneous and time lag releases. These are shown in detail in Fig. 3.

At the top of the breaker the three line contacts are situated between the

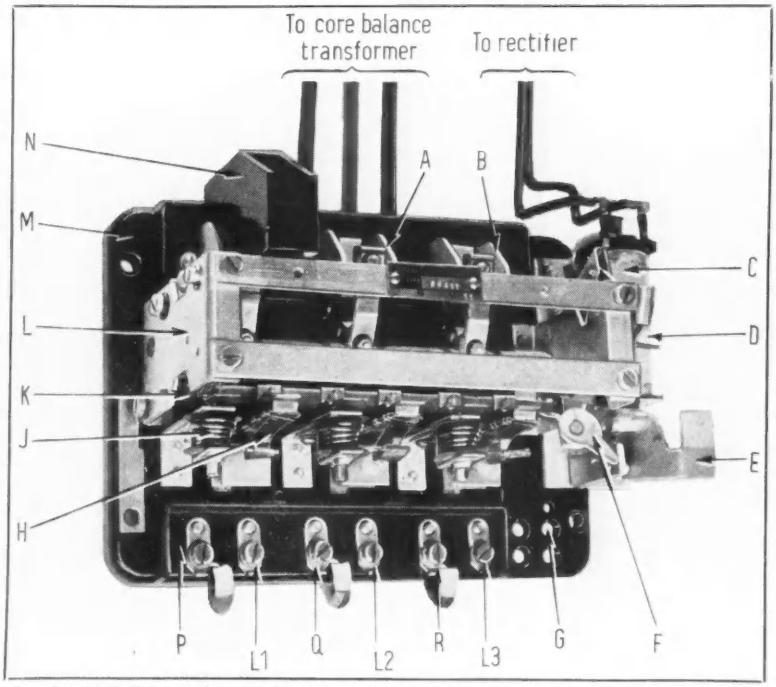
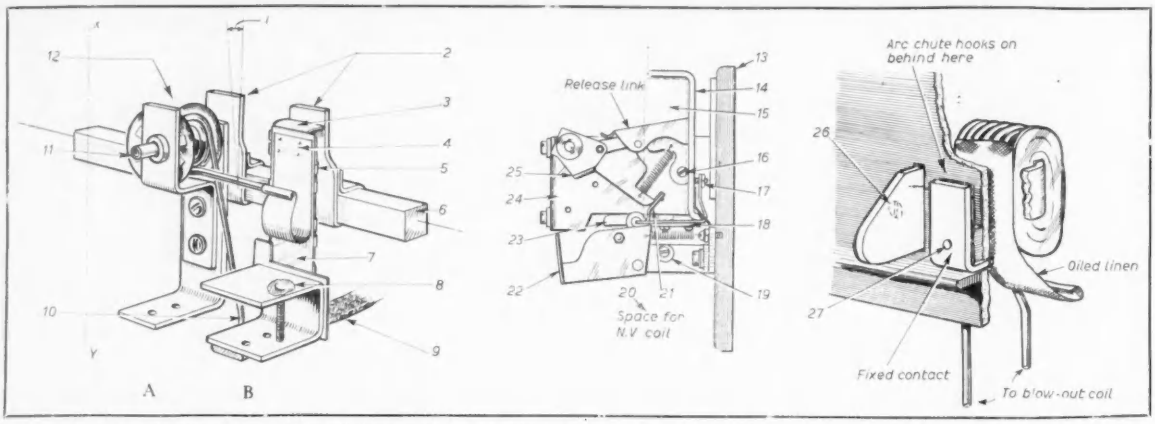



*Fig. 2. Internal view of circuit-breaker mechanism. A, blow-out horn; B, moving contact; C, earth-leakage solenoid; D, tongue to engage handle in lid; E, earth-leakage trip flag; F, adjusting cam; G, space for no-volt coil; H, time lag overload; J, short-circuit release; K, trip bar; L, frame; M, base; N, arc shield; P,Q,R, terminals*




*Figs. 3–5. Circuit-breaker details. Fig. 3 (left): overload mechanism, one phase only shown. The instantaneous release is on the left (A) and the time lag heater strip on the right (B). When the unit is in position, X—Y is horizontal. Fig. 4 (centre): right side elevation of closing and tripping mechanism in "make" position. Fig. 5 (right): blow-out coil and arc chute support. Reference numbers are indexed below, right*

horns of the blow-out coils (mounted behind the panel). These horns and the contacts themselves serve to retain the arc chutes in position. Provision is made below the earth-leakage solenoid for a no-volt coil which is not fitted in the example illustrated.

### *The Overload Trips*

In Fig. 3 the construction and operation of the two trips can be clearly seen.

On the left (A) is the instantaneous trip with a few turns of heavy wire and a small plunger (11) which acts as a striker pin and trips the striker plate (2) on short-circuit. On the right (B) is the wire wound heater enclosing the mica-covered bi-metal trip, the arm of which (3), acting on its own striker plate (2) moves the trip bar on time lag. The base of this time lag is adjustable but is sealed by the manufacturers. The relative position of the six striker plates, mounted on the trip bar, is adjustable by the cam F (Fig. 1) and enables the thermal overload to be varied by ±20% of rated current.

### *The Breaker Linkage*

Fig. 4 shows this in detail.

The main contact bar (16) is closed by a handle on the breaker cover which engages a steel tongue (25) and D (Fig. 1). It is not possible to close the breaker until the linkage arm is held by a small catch at (21). This catch is mounted on the end of the small trip lever (23) which is controlled both by the overload trip bar K and by the flag arm (22) of the earth leakage trip. Should either of these releases operate, the trip lever will be moved and so prevent the small catch at (21) from operating. This will make closure of the breaker impossible. Note that the earth leakage indicator flag is part of the trip mechanism and is normally held by the small armature (18) of the earth leakage trip solenoid. The movement of this armature is also adjustable but is sealed by the maker. In the illustration the actual coil is shown dotted for the sake of clarity.

### *The Core-balance Transformer*

In this model the core-balance transformer is housed in a separate case and consists of:

1. Three separate primary windings, one for each phase, connected in series with the output terminals and terminals P, Q, R on the circuit-breaker base.

2. The secondary winding wound next to the core.

This secondary winding is connected to a small full wave metal rectifier of the instrument type also housed in the top case and from this d.c. is supplied to the earth leakage solenoid, if there is a leakage from the protected circuit to earth.

### *Maintenance*

First and foremost, mechanism of this type should not be tampered with unnecessarily. Cleanliness is of course of prime importance and the well sealed lids and blanking plates should prevent the entry of dirt.

In addition:

1. Make sure that the instantaneous release plungers are free in their solenoids.

2. If it is necessary to adjust the calibrated cam do so with care because immediately above it is the light trip lever (23 Fig. 4) which could be bent by careless treatment.

3. All moving parts (thirteen in all) should be checked for freedom. Since it is a sealed unit lubrication should not normally be necessary but a corrosive atmosphere may demand a minute spot of lubrication on the pivots.

4. Any alteration in the current range of the trips will necessitate re-calibration and readjustment and the unit should be returned to the makers.

5. The setting of the earth-leakage trip is, by necessity, delicate. The hinge of the solenoid is of the knife-edge pattern and the moving armature itself is adjusted and sealed by the makers. Any alteration is liable to affect the current setting.

6. The movable contacts can be changed easily but the fixed contacts require the removal of the blow out coils as a first step. To do this undo the screw (26 Fig. 5) on either side of the blow out horns. This screw is locknutted behind. The blow out coil can now be pulled back and expose the head of the screw (27) holding the fixed contact.

7. All terminals are readily accessible for testing purposes.

8. Keep all nuts and screws tight.

1, adjustment by calibrated came on end of trip bar; 2, striker plate; 3, striker arm from thermal trip; 4, tinned copper connecting strip; 5, heater; 6, insulated trip bar; 7, mica; 8, adjusting screw (sealed); 9, copper braid to phase contact; 10, to blow-out coil; 11, striker pin (armature); 12, overload coil; 13, base plate; 14, earth-leakage trip coil base; 15, trip coil (dotted in); 16, shaft of c.b. arm; 17, adjusting screw (sealed); 18, armature of trip coil; 19, adjustable stop; 20, space for n.v. coil; 21, catch on trip lever; 22, indicating flag (reset by key on lid); 23, trip lever-operated by trip arm and by flag arm; 24, frame; 25, main c.b. arm (engaging device on lid); 26, fixing screw; 27, contact fixing screw.

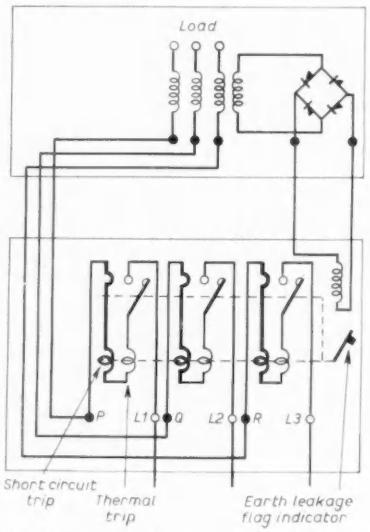



*Fig. 6. Circuit diagram of circuit-breaker connections. The core balance unit is at the top*

# Corrosion in Transformer Tanks

AN attendant whilst cleaning a transformer in an indoor substation, noticed a slight bulge in one corner of the top plate, and was surprised when wiping this to see a hole appear of about ½ in. in diameter. The transformer was later taken off load, and after isolating, the lid was removed and found on the inside face to be badly corroded, particularly at each corner. The tank sides seemed unaffected, the corrosion having only attacked the lid at each corner, the worst spot being the one revealed when cleaning. It was apparent after close examination that the lid was not air tight, particularly at the corners which had been welded during the tank fabrication, and moisture "breathed" from the atmosphere had initiated corrosion at these points.

The transformer is a most reliable electrical device requiring but infrequent overhaul, and then, in general, only when there are specific signs of trouble. In oil immersed transformers the oil fulfils two functions, to remove heat from the windings and maintain their insulation. The presence of moisture, whilst not affecting the first of these functions does affect the second, as the breakdown voltage is lowered by dissolved moisture. Transformer oil is also liable to oxidation if oxygen is present, as in moisture, and this produces sludge and acids. Neglecting the possibility of leakage of water from outside into the transformer, the absorption of water vapour from the atmosphere may take place due to breathing. Some improvement can be made by having the lid air-tight so that only a definite amount of moisture can be trapped in the internal air, and by fitting breathers filled with a de-hydrating agent. To fill the whole of the tank with oil, as in the conservator tank type, is the best method. It is found from experience that this type rarely develops undue acidity.

### *Tests and Remedy*

The transformer with the corroded top plate was a non-conservator type, running at full load for considerable periods. Oil samples had been taken annually for dielectric and acidity tests, the last report showing 40 kV for one minute and 52 kV breakdown, the acidity being 1·0 mg KOH/gm. Oil filtering was carried out each second year, but no actual inspection of the interior had been undertaken since its installation.

A new top plate was manufactured from ¼ in. plate and treated on the inside face with first and second coats of "Tanctectol" paint, which is based on a special synthetic resin, anti-corrosive and unaffected by petroleum products and moisture. Tanctectol paste was used to seal the lid and tank flange, making a perfect air tight seal. A silica gel breather was fitted to the transformer to de-hydrate the air entering the tank. To facilitate internal examination of the transformer without breaking the main seal, two small inspection plates were fitted on the top and sealed off in a similar manner. Removal of these two small covers allows, with the aid of torch and mirror, the whole of the top to be examined. These modifications have now been in service for two years and the last examination showed the top plate entirely free from corrosion.

This experience illustrates that oil testing and filtering is not sufficient for transformers not fitted with conservator tanks, for though these tests may be satisfactory, a periodical examination of the internal face of the top plate should be made to detect any corrosion that may be taking place in the air space, due to moisture and oil acidity.—*T. H. Snelson.*

# Commutators and Slip-Rings

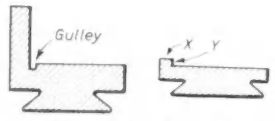
DATA Sheet 11, published in the November *Industrial Maintenance*, dealt with the maintenance and fitting of commutators and brush gear. These notes are continued here with additional attention to slip-rings.

### *Machining*

(1) Do not machine unnecessarily and remove a mature surface.

(2) After machining, the undercutting may require deepening and certainly cleaning out and inspecting.

(3) An armature or rotor should always be tested (growl or volt drop) after machining. Many have been burnt out because the bars have been bridged at the end of the cut at the foot of the risers.




*Figs. 15 (left) and 16. Commutator details*

(4) 3 points to watch:
- (*a*) A gulley in a large commutator is an advantage (Fig. 15).
- (*b*) In small commutators do not machine back at X at all, and very little at Y (Fig. 16).

(5) If machining is not convenient grinding with a commutator stone is quite suitable unless the commutator has a very long and deep flat. It may be necessary to mask the risers on an open winding before the job is started and certainly to blow out all dust afterwards. If possible the brushes should be lifted or alternatively a piece of cloth held in advance of the first set of brushes after the stone.

### *Sparking*

Assuming all the conditions discussed earlier here and in Data Sheet 11 are satisfied, sparking can be due to:
(1) Faulty windings.
(2) Incorrect connections.
(3) Nominally correct connections but with wrong direction of rotation. (For example, most universal (series) f.h.p. motors have a lead on the comm throw suitable for one direction only.)
(4) Incorrect brush position.
(5) Overload.

### *Whistling, Chattering and Chipping of Brushes*

All can be due to:
(1) Excessive clearance in box.
(2) Excessive distance of box from comm surface.
(3) Incorrect grade.
(4) Radial commutators.

In larger repulsion-start, induction-run machines with lifting brush gear, the brushes strike the commutator with considerable force when the centrifugal gear closes and the brush edges are frequently chipped off. A slight bevel on the brush edge may help as a temporary expedient.

### *Slip-Rings*

In small and medium machines the slip ring and brushes give very little trouble. Many of the points dealt with in the previous section are equally applicable to the brush gear on slip-rings with perhaps the following additions:

(1) When the brush is held in a pivoted arm take care that the brush has not moved in its socket after it has been lifted for inspection, see Fig. 17.

*Fig. 17. Slip-ring detail showing brush which has moved in socket*

(2) Some early types of slip-rings were moulded solid and developed cracks and distort when old. (This does not apply to the rings on very small rotary convertors and lighting plants.)

(3) The spider type of slip-ring will also distort when the ring becomes too thin.

(*Concluded.*)

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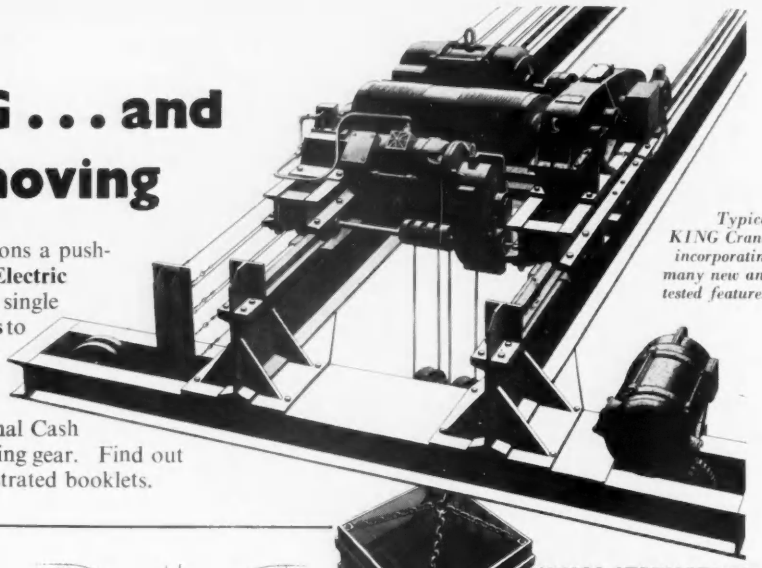

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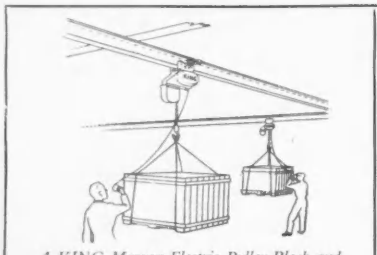
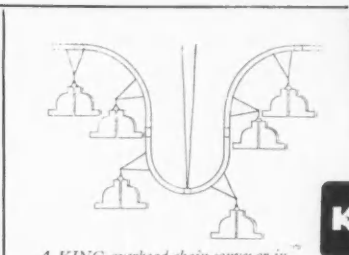
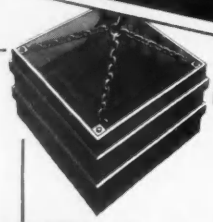


*A KING Marvex Electric Pulley Block and runway*



*A KING overhead chain conveyor in action*



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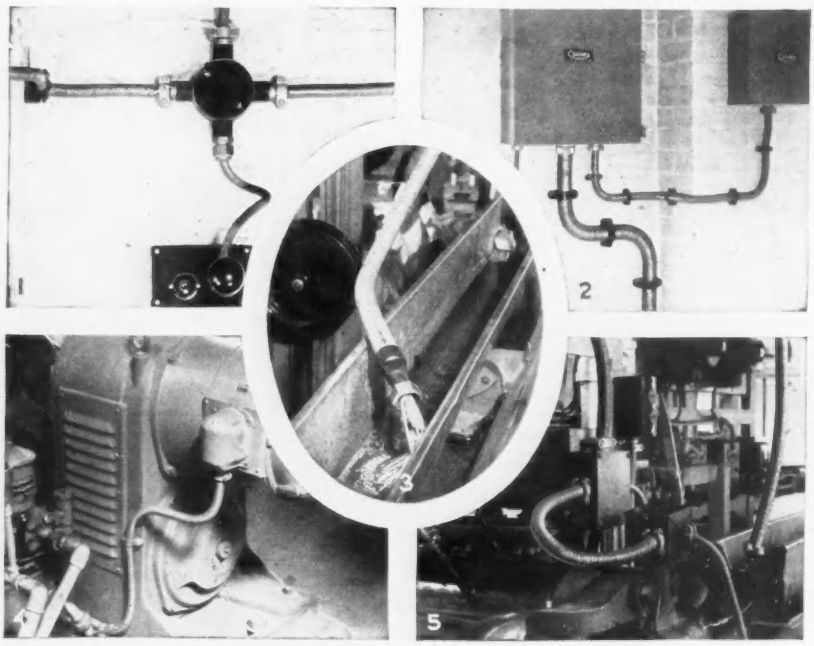


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# Installing Earth Electrodes

## *N.C.B. Practice favours Coke and Rod Types*

EARTH electrodes require careful attention if they are to maintain a low resistance with the general mass of earth over a long life. The safety of both personnel and apparatus may depend on their efficiency in an emergency in passing a sufficiently large current to operate automatic protective gear. There are several types of electrode in use, and most of these are surveyed in a valuable bulletin* issued recently by the National Coal Board under the title "The installation and testing of earth electrodes." The bulletin is written, not unnaturally, in the light of the requirements of the General Code of Regulations under the Coal Mines Act, 1911 (now superseded by the Mines and Quarries Act, 1954); however, in the 1941 Draft Regulations a figure of 2 ohms is mentioned for the earth electrode resistance, and this is generally accepted as reasonable and attainable.

### *Coke Electrodes*

One common form of earth electrode is the coke electrode, which has the advantages of very long life and an ability to dissipate heavy fault currents. It usually takes the form of metal plates or pipes, or a large scrap casting, placed in a pit and surrounded by coke breeze. As described in the Bulletin, the simplest form of the coke electrode necessitates the digging of a pit 6 ft to 9 ft deep. Coke breeze is laid at the bottom of this to a depth of about 1 ft. Cast iron pipes (two, three or more) are placed side by side standing upright on the bed of coke, and the pit is then filled with coke breeze up to ground level, care being taken to ram it well down. The top flanges of the pipes, projecting about a foot above the coke, are bonded together using copper or brass strip, and brass bolts and nuts. The earth continuity conductors are then connected to the bonding. A low brick wall or concrete kerb may, with advantage, surround the pit.

The basis of the design of such an electrode is the fact that its effective resistance depends only on the resistance of contact between the electrode and the soil, and the resistivity of the ground beyond the electrode. The resistivity of well rammed coke breeze is usually about 40 ohms/cm (i.e., ohms per cm cube), very small compared with the soil values. Moreover, the resistance between the metal rods and the coke should be negligible. The important factor is the contact resistance between the coke and the soil: the coke tends to increase the area of contact, and thus reduce the resistance.

* *Production Department Information Bulletin No.* 54/131.

The formula for the resistance of a coke electrode used by the N.C.B. is

$$R^2 = \frac{144}{A}\left(\frac{\rho}{1000}\right)$$

where R = total electrode resistance, ohms
$\rho$ = resistivity of soil, ohms/cm
A = total area of contact between coke and soil, sq ft.

For instance, to give 2 ohms resistance in gravel of 10,000 ohms/cm resistivity, 360 sq ft of contact area is required. Calculation shows that this requires a pit 7½ ft square in section and 10 ft deep, needing no less than 7½ tons of coke to fill it. It is good practice, however, to provide at least two earth electrodes, so that testing may be carried out without complete disconnection of the system from its earth. With two electrodes in parallel (they will need to be sufficiently far apart) then for 2 ohms resistance, the value of each can be 4 ohms. This reduces the required area to 90 square feet (it will be noticed from the formula that the area is inversely proportional to the square of the resistance, so that doubling the area gives one-quarter of the resistance). Pits 3½ ft square by 6 ft deep now become sufficient, with about 1 ton of coke each.

### *Rod Electrodes*

For power stations and substations, notably on supply systems, standard practice is to use copper or steel rods of between ½ and 1 in. diameter and 10 ft or more in length. In evaluating electrodes of this type, the Bulletin points out that they require no excavation and are thus cheaper to install than other types; they are, however, less permanent, being more susceptible to corrosion than the coke electrode. For this latter reason they are less satisfactory for "made" ground which contains ashes. Rods offer a particular advantage when the subsoil consists of gravel or sand with clay underneath; they can be readily driven through to the low resistivity clay layer.

For a single rod, the resistance formula suggested by the N.C.B. is:

$$R = \frac{\rho}{83L}\log\left(\frac{48L}{d}\right)$$

where $\rho$ = soil resistivity, ohms/cm.
L = length of rod, in feet.
d = diameter of rod, inches.

For instance, a 10 ft rod, ¾ in. diameter, has a resistance of 34 ohms in soil of 10,000 ohms/cm resistivity. To give 2 ohms resistance, 17 rods would be required: it is suggested that they should be so spaced that the resistance between any two rods is at least twice the length of each rod. If this is not done, the effective resistance areas will overlap, and the resultant resistance will be higher than anticipated. (This effect was discussed in the ELECTRICAL TIMES on 7 Jan. and 18 Mar., 1954). In the case quoted, the electrodes would occupy a ground area of 100 ft by 40 ft.

For driving the rods, the use of light electric or compressed air hammers is well known. If driving is done by hand, it is suggested in the Bulletin that nothing larger than a 4 lb hammer should be used, for fear of bending the rods.

### *Strip Electrodes*

Subsoil commonly has the characteristics just discussed, with the upper layers being of the higher resistivity. However, there are cases where there is a shallow layer of subsoil lying over rock or sand. It is in such circumstances that the use of strip electrodes is worth considering. Bare copper strip or stranded copper conductors may be laid at a depth of 18 in. either in a continuous length or in separate lengths radiating from a central point. The N.C.B. formula for strip is:

$$R = \frac{\rho}{250L}\log\left(\frac{216L^2}{wt}\right)$$

where $\rho$ = resistivity of soil, ohms/cm.
L = length of electrode, yards.
t = depth of burial, feet.
w = width of strip, inches.

If a stranded conductor is used the expression in the bracket should be changed to

$$\frac{108L^2}{dt}$$

Where d = diameter of stranded conductor, inches.

Once again considering soil of 10,000 ohms/cm resistivity 2 ohms total resistance requires 400 ft of 1 in. by ⅛ in. strip or 0·1 sq in. section stranded conductor. Strip electrodes are particularly sensitive to seasonable variations in the dampness of the soil, the Bulletin warns. A naturally moist site should be chosen if available.

The use of plate electrodes is dismissed in the Bulletin as "dying out." An example is quoted of a 3 ft square plate buried with its centre 6 ft below the surface in 10,000 ohms/cm soil. Its resistance is 27 ohms, compared with 34 ohms for a single ¾ in. rod 10 ft long. There is also some dislike apparent for the use of water mains, and it is recommended that they never be relied upon as the main earth electrode. This is because of the use of relatively high resistance jointing materials between sections, and of the substitution of pipes of asbestos cement or plastic materials.

This most interesting Bulletin concludes with some notes on the testing of earth electrodes.

# *Maintenance for Electronic Instruments*

MOST maintenance engineers approach electronic equipment with considerable suspicion. Some figures on fault rates in instruments involving electronic components were presented by Dr D. Taylor when he opened a discussion recently for the Measurements Section of the I.E.E., and they suggest that this attitude has only a limited foundation. Speaking of the experience in atomic energy projects, he said that standard type laboratory instruments had fault rates of about 0·5 to 1·5 faults per year. Experience with servicing showed that at the present time, many of the components the instrument designer has to use fall short of the performance required. Even with specialised instruments used in nuclear research, the failure rates are highest for the more orthodox components such as thermionic valves and resistors.

Analysis of faults in electronic apparatus operated by A.E.R.E. shows that thermionic valves account for 70% of all failures, with rectifier tubes the worst offenders. Their failure rate of 6% per annum compares with 0·4% for selenium rectifiers. For vesconol and nitrogol capacitors, failure rates are down to a small fraction of 1% per annum. For resistors of the high stability type the failure rate may be 0·7%, which is not considered very satisfactory. Figures quoted of Canadian experience show that similar resistors of American manufacture have a failure rate of 0·02% per annum. It needs to be noted, however, that designers of instruments in the Canadian project derate all their resistors by 50%.

Servicing of Atomic Energy Authority electronic equipment is carried out in two stages. Certain personnel are responsible for routine inspection of complete instruments and for first-line maintenance. Repair work involving the replacement of components, however, is carried out away from the plant room or laboratory. It is the duty of the visiting service men in such cases to localise the fault to a particular unit and replace this unit. The repair of the faulty unit is then undertaken in the repair shop by industrial labour, using as far as possible standard test rigs.

Recently, with the more elaborate instruments, marginal testing facilities have been provided. In this technique, equipment is subjected to changes in currents and voltages that narrow the margin of safety. It is a preventative maintenance approach which should prevent the failure of equipment due to a slow drift in characteristics.

In the discussion that followed this introduction, there was general endorsement of the principle of performance tests *in situ* with replacement of components where possible carried out by specialist personnel in a separate workshop. Among aids to maintenance mentioned, the value of instruction manuals and of monitoring points on instruments stood out. In general, it was thought that valve reliability is increasing and the use of specially selected long-life valves is growing.

# EXPERIENCE WITH TRACTION MOTORS

VACUUM impregnation of motors has become a fetish with electrical machine manufacturers, but there is considerable doubt if it does any good. This was one of the opinions expressed during the discussion on the paper on traction motor maintenance presented by Mr J. G. Bruce to the I.E.E. recently, and summarised in the November *Industrial Maintenance*. The speaker, Mr A. W. Manser (Chief Mechanical Engineer, Railways, London Transport) went on to say that during the war he had seen stripped down a number of machines that had been under sea water for times varying from a few hours to a few months. In every case, salt had got into all the crevices, which could not have happened had the machines been sealed. He suggested that it has to be accepted that machines cannot be sealed completely; different methods must be adopted to prevent electrical breakdown.

In his paper, Mr Bruce gives a list of causes of armature breakdown, but Mr Manser felt it necessary to add another. Carbonisation of insulation was his extra cause, and it is particularly troublesome on traction motors, which are liable to be overloaded and subjected almost continuously to expansion and contraction. In this respect the use of silicone materials appears most promising, because with some of them it is possible to achieve a degree of elasticity which will take care of the expansion and contraction of the armature bars, as well as tolerate overheating.

A sidelight on electrical testing at the Acton works of London Transport was given by Mr H. H. C. Barton (Merz and McLellan). Referring to the test runs carried out with overhauled motors, he said that the resistances used for controlling the motors are installed so that they "cook" other armatures which are in the ovens after treatment or repair.

There was some more comment on the value of silicone insulation from Mr H. Newsam (Metropolitan-Vickers) who spoke as a designer. He thinks that this and similar advances in insulation technique can be valuable not so much in putting up the temperature at which the motor is run as in increasing the life of the insulation when running at the present temperature. On the subject of testing, he remarked on the opportunity offered by high-frequency or surge-testing apparatus of testing between conductors in the same way that a machine is flashed to ground at different stages of repair and manufacture.

Bearings were mentioned by Mr W. E. Lewis (G.E.C.) who tackled comments on the life of roller bearings in traction motors. At the basis of this problem, he sees the fact that bearings are assembled from components made to tolerances, so that there are variations in the clearances of the running parts. Methods providing controlled beeding of oil, and thus keeping the parts continuously covered with a fine oil film may extend the life of particular bearings which would otherwise have a short life.

The value of core ducts was a subject of disagreement between several speakers in the discussion. Mr W. J. A. Sykes (British Railways) noted that London Transport is considering the use of a totally enclosed motor, while the Southern Region of British Railways is trying to develop a motor which will run satisfactorily with ventilation, after being attacked for many years for using nothing but t.e. machines. Mr R. Ledger commenting that London Transport has gone part of the way towards a t.e. motor by eliminating the usual ventilation through the core, expressed some doubt as to this being justified. Mr E. Webster, on the other hand, had little doubt on the matter. In his view core ducts become blocked up, and either the motor must be run at a lower rate than it was designed for, or it must be made bigger to give the desired rating. It is a complete fallacy, in his view, to believe that a core duct is any use at all. Then came Mr J. N. Briggs, who in disagreeing with the statement that core ducts are useless, made the proviso, at any rate in open air where blocking is less likely to occur.

A suggestion was made in the paper that there is less wear on brush boxes when pigtails are fitted to brushes, as compared with current transfer through contact hammers at the end of springs. Referring to this, Mr D. E. Dodridge suggested that here the difficulty is to find a means of securing the pigtail so that it does not come out, flap about inside the motor and cause flashovers. Another speaker dealing with brush wear thought that in t.e. motors insulated with silicone materials, conditions can arise which cause brush wear to be abnormal. In the opinion of a further speaker, there seems to be a tendency for railways to require an abnormally high pressure for a new brush, so that the pressure does not have to be adjusted during its life. The Americans, he said, begin with a pressure of 7 to 8 lb/sq in.

# COMMERCIAL INFORMATION

## Contracts Open at Home . . .

*Dates given are the final for receipt of tenders unless otherwise stated.*

**17 Dec.—Antrim.** Equipment for Moyle Hospital, Larne.—See 2 Dec. issue.

**17 Dec.—Rayleigh U.D.C.** Fluorescent and sodium lighting in High St: and along trunk road A 129.—See 9 Dec. issue.

**18 Dec.—Ipswich T.C.** Group A sodium discharge lanterns, lamps, etc., along Colchester Rd.—See 9 Dec. issue.

**18 Dec.—Mossley T.C.** Street lighting on Micklehurst estate.—See 2 Dec. issue.

**18 Dec.—Wembley T.C.** Lamps in year from 1 April.—See 25 Nov. issue.

**20 Dec.—Washington (Dur.) U.D.C.** Installation in houses, shops and flats in Oxford Ave and Coach Rd.—See 9 Dec. issue.

**21 Dec.—Antrim.** Installation at Moyle Hospital, Larne.—See 2 Dec. issue.

**21 Dec.—Ashton-under-Lyne T.C.** Group A street lighting units along Oldham Rd and Cavendish St.—See 9 Dec. issue.

**21 Dec.—Dublin T.C.** Installations in former Fever Hospital, Cork St.—See 2 Dec. issue.

**21 Dec.—Ilford T.C.** Installations in 119 houses.—Advertised in 2 Dec. issue.

**21 Dec.—Innerleithen T.C.** Installation in 58 houses.—See 9 Dec. issue.

**21 Dec.—Poole T.C.** Installation of electrical plant for Broadstone sewage works.—See 18 Nov. issue.

**23 Dec.—Co. Down.** Installation at Ards Hospital, Newtownards.—See 9 Dec. issue.

**23 Dec.—Dorchester T.C.** Equipment for mercury discharge lighting units along trunk road A.35.—Advertised in 18 Nov. issue.

**27 Dec.—Renfrew.** Electrical installation in R.C. primary school at Broadfield, Port Glasgow. Applications to Robert Urquhart, county clerk, County Buildings, Paisley, by above date.

**28 Dec.—Morpeth T.C.** Group A sodium vapour lighting units on steel columns along trunk road A.1.—See 2 Dec. issue.

**28 Dec.—Pembrokeshire.** Electrical installation in proposed infants' schools at Pembroke Dock and Haverfordwest. Name to W. Barrett, county architect, County Offices, Haverfordwest, by above date. Deposit £2. 2s.

**29 Dec.—Hertfordshire.** Supply of electric lamps in year from 1 Apr. County Purchasing Officer, Old Rectory, French Horn Lane, Hatfield.

**29 Dec.—Northumberland.** Electrical work in adaptations of existing air raid sirens at ten fire stations. County Surveyor, Phoenix Hse, Newcastle-on-Tyne.

**29 Dec.—Radcliffe T.C.** Sodium street lighting units along trunk road A668.—See 9 Dec. issue.

**30 Dec.—Belfast T.C.** Analytical balance, titration bench and conductivity meter.—Advertised in 9 Dec. issue.

**30 Dec.—Co. Kerry.** Boiler feed pumps, hot water accelerators and sod breaker at Mental Hospital, Killarney.—See 2 Dec. issue.

**30 Dec.—Edinburgh T.C.** Rewiring at Portobello swimming pool.—See 9 Dec. issue.

**31 Dec.—Belfast T.C.** Stores requirements and condenser tubes, tube plate ferrules and packing, and coal conveying plant.—Both advertised in 2 Dec. issue.

**31 Dec.—Bredbury and Romiley U.D.C.** —Supply and installation of 140 W and 60 W sodium street lighting units along Ashton Rd, B.6017, for about 1½ miles. Engineer and Surveyor, Council Offices, George Lane, Bredbury. Deposit £2. 2s.

**31 Dec.—Chippenham T.C.** Electrically operated pumping set at Ivyfields station. —See 9 Dec. issue.

**31 Dec.—Durham.** Electrical installation in Jarrow Ellison C.E. (Controlled), Framwellgate Moor county junior, Horden special, Felling Wardley county infants', and Stanley county infants' schools, and Bishop Auckland Technical College. Apply by above date to C. R. Clayton, County Architect, Court Lane.

**31 Dec.—Failsworth U.D.C.** Supply and erection of 61 group B columns, sodium discharge lamps, lanterns, etc., along four streets. Engineer and Surveyor, Town Hall. Deposit £1. 1s.

**31 Dec.—Grimsby T.C.** Installations in special school in Carnforth Crescent.—See 2 Dec. issue.

**31 Dec.—Manchester T.C.** Multi-core cable for automatic control purposes at Haweswater works, Westmorland.—Advertised in 9 Dec. issue.

**31 Dec.—Manchester T.C.** Installation at Plant Hill secondary school.—Advertised in 2 Dec. issue.

**31 Dec.—Wandsworth B.C.** Lamps in year from 1 Apr., and electrical works for three years.—See 25 Nov. issue.

**1 Jan.—Lichfield T.C.** Supply of electrical fittings required in year from 1 Apr. D. Oglesby, City Engineer and Surveyor, Guildhall.

**3 Jan.—Chertsey U.D.C.** Group A mercury vapour street lighting along Eastworth and Chertsey Rds.—See 9 Dec. issue.

**3 Jan.—Lancashire.** Supply of 75 frequency modulated mobile wireless equipments for Fire Brigade. Clerk of County Council, P.O. Box 78, County Hall, Preston.

**3 Jan.—Richmond (Yorks) R.D.C.** Ejector plant and pumping plant for Gilling and Aldborough sewerage.—See 2 Dec. issue.

**5 Jan.—Macclesfield T.C.** Group A, G, and B sodium lighting units on concrete columns.—Advertised in 9 Dec. issue.

**6 Jan.—Belfast T.C.** Extensions to low pressure piping installations at Power Station West. — Advertised in 25 Nov. issue.

**6 Jan.—Harwich T.C.** Electrical installation in block of 12 flats in Cliff Rd, Dovercourt. Borough Architect, Town Hall, Deposit £2. 2s.

**7 Jan.—Birmingham T.C.** Installation of lighting and power and a lift in aged persons' home, Serpentine Rd. Sir H. J. Manzoni, City Engineer and Surveyor, Civic Centre. Deposit £2. 2s.

**7 Jan.—Sheffield T.C.** Installations at colleges of technology and commerce in Pond St.—See 25 Nov. issue.

**8 Jan.—Dagenham T.C.** Lamps, cables, conduit and accessories in year from 1 Apr.—See 9 Dec. issue.

**8 Jan.—Ruislip - Northwood U.D.C.** Lamps in year from 1 Apr.—See 2 Dec. issue.

**10 Jan.—West Riding.** Rewiring in Harrogate Technical school.—Advertised in 9 Dec. issue.

**12 Jan.—Dublin.** Three electric goods lifts for Port and Docks Board.—See 9 Dec. issue.

**12 Jan.—Dublin.** Three overhead travelling electric gantry cranes.—See 2 Dec. issue.

**16 Jan.—Whiston (Lancs) P.C.** Supply, erection, etc., of sodium vapour discharge lighting units on Liverpool-Warrington trunk road A.57 for about 780 yd. Documents from The Clerk, Whiston P.C., 38 Ford Rd, Whiston, Prescot. Deposit £2. 2s.—Advertised in this issue.

**17 Jan.—Exeter T.C.** Vertical spindle electric pump at Countess Wear sewage works.—See 9 Dec. issue.

## Your Queries Answered

*Readers are invited to make use of our free enquiry department which possesses wide resources including an index of trade information with over 100,000 entries*

***A Selection from the 135 queries answered this week***

**"ELC" two-way lampholder adaptors,** makers of? J.M.C.—Electrocraft Ltd., 27 Cassel Ave, Bournemouth West.

**"Westinghouse" irons,** agents for? T.B.C. —Refrigeration Service (South London) Co., 245 Burlington Rd, New Malden, Surrey.

**Electrolytic capacitors 200 m.f.d. 450/500 V,** makers of? R.D.—This refers to the SCE 60 PE "Lectroflash," by Telegraph Condenser Co., Ltd., Wales Farm Rd, W.3.

**Dead weight type water flow indicator for about 1,700 gallons per hour to denote the stoppage of flow by actuating an alarm bell and/or flashing light,** makers of? W.H.S.—Londex Ltd., 207 Anerley Rd, S.E.20; Igranic Electric Co., Ltd., Bedford, state that they can supply.

**"Multiplex" lamps,** makers of? D.W.—B.E.C. (British Electric Corpn.) Ltd., 216 Columbia Rd, E.2.

**"Windovent" fans,** makers of? B.C.—Air Control Installations Ltd., Ruislip, Middx.

ANSWER WANTED

**Ground base electric kettle 1½ or 2 kW—3 or 4 pints,** makers of? M.E.B.

**18 Jan.—Ilfracombe U.D.C.** Supply and erection of 145 concrete columns with 73 fluorescent and 72 sodium lanterns and ancillary equipment in group A. Also removal of existing columns. Engineer and Surveyor, Council Offices. Deposit £2. 2s.—Advertised in this issue.

**19 Jan.—Fareham U.D.C.** Supply of electrical fittings and lamps in year from 1 Apl. Engineer and Surveyor, Westbury Manor, West St.

**21 Jan.—Dundalk U.D.C.** Two pumping units with accessories for water supply augmentation scheme.—See 2 Dec. issue.

**24 Jan.—Lanarkshire.** Electrical installation in new fire station in Cleghorn Rd, Lanark. Gavin Paterson and Son, architects, 6 Cadzow St, Hamilton.

**24 Jan.—Newcastle-on-Tyne.** Electric cargo-grabbing cranes at Albert Edward Dock.—See 2 Dec. issue.

**31 Jan.—Antrim R.D.C.** Supply and erection of five sewage pumps, with control gear, heating and lighting at new Disposal Works. Consulting engineers, W. D. R. and R. T. Taggart, Castle Arcade Bldgs, Belfast. Deposit £3. 3s.

**No date stated.—Aberystwyth.** Electrical installation at Aberayron and Tregaron Chest Hospitals. Documents from Secretary, Mid-Wales Hospital Management Comm., General Hospital, Aberystwyth.

**No date stated—Crawley (Sussex) P.C.** Supply of 18 25 ft concrete columns and fluorescent lanterns. Clerk, Robinson Hse, Robinson Rd.—Advertised in this issue.

**No date stated—Merthyr Tydfil.** Electrical installations in hospitals under Merthyr and Aberdare Hospital Management Committee. Contractors willing to carry out maintenance contracts should apply to Group Secretary, St. Tydfil's Hospital, Merthyr.

**No date stated.—Fifeshire.** Installation in primary school at Leven.—See 9 Dec. issue.

**No date stated.—Romford T.C.** Lamps included in annual tenders invited for materials.—See 9 Dec. issue.

**No date stated.—N. of Scotland H.E. Board.** 132 kV switchgear for Clunie substation.—Advertised in 9 Dec. issue.

**No date stated.—Somerset.** Supply of heavy duty cooking equipment. Chief Education Officer, County Education Office, Trull Rd, Taunton.

## . . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon House, Theobalds Rd, W.C.1, quoting reference.*

**5 Jan.—South Africa.** Supply of total of 7,000 ft underground armoured cable, lead sheath, paper insulation, for Stores Dept., S. African Railways. B.o.T. (Ref.: ESB 28622/54).*

**7 Jan.—Philippines.** Galvanised steel towers, leg extensions and appurtenances for Ambuklao-Poro 69 kV transmission line. National Power Corpn., N.P.C. Bldg, Bonifacio Drive, Port Area, Manila. B.o.T. (Ref.: ESB 28111/54).*

**17 Jan.—India.** Supply and erection of cooling towers and auxiliary apparatus for extension to Madras Basin Bridge B power station. Specification No. C.533. Superintending Engineer, Technical (Civil), 157 Mount Rd, Madras.

**27 Jan.—Australia.** Supply of three 66 kV circuit-breakers and one potential transformer for State Electricity Commission of Western Australia, Perth. Specification No. 15/BUN. B.o.T. (Ref.: ESB 27972/54).*

## PRICES of cable metals and other materials

***Figures quoted are the official prices ruling on Tuesday, 14 December***

| | £ per ton | Weekly change £ | Price last year £ |
|---|---|---|---|
| COPPER, standard class A (settlement) | 277 | −4 | 228½ |
| ,, (3 months) | 265½ | +½ | 218½ |
| LEAD, refined pig, min. 99·97% purity (cash) | 103½ | −½ | 90 |
| ,, (3 months) | 103 | −½ | 88½ |
| TIN, refined, min. 99·75% purity (settlement) | 713 | −3 | 640 |
| ,, (3 months) | 713 | −1 | 620 |
| ALUMINIUM, ingots 99·99·5% | 156 | — | 150 |
| ZINC, virgin, min. 98% purity (cash) | 84 | −1¾ | 74 |
| ,, (3 months) | 83 | −1 | 73⅝ |
| RUBBER No. 1, RSS, spot (per lb.) | 24¾d. | +⅛d. | 17½d. |
| ,, c.i.f. basis, ports, Feb. (per lb.) | 24⅛d. | +⅜d. | 17¾d. |
| ARMOURING: | | | |
| Galv. Steel Wire (0·104 in.) | 52½ | — | 51½ |
| Mild Steel Tape (0·014 in.) | 40½ | — | 40 |

**27 Jan.—New Zealand.** Supply of 55½ miles of various types of telephone cable, textile covered and sheathed in pure lead or lead alloy. Stores Div., G.P.O., Windsor Building, 4 Willis St, Wellington.

**28 Jan.—New Zealand.** Post and Telegraph Dept., Wellington, invites tenders (P. and T. 150/7556) for supply of 16,000 ft twin-twisted cable, 3/·029 TRS or TPS 660 V grade. B.o.T. (Ref.: ESB 27777/54).*

**1 Feb.—Egypt.** Tenders invited for supply of 63 kV underground cable system and associated switching stations including cables, switchgear, circuit-breakers, lighting, etc. Cairo Electricity and Gas Administration, 53 Sharia 23 Yulin, Cairo. B.o.T. (Ref.: ESB 27158/54).*

**1 Feb.—Iraq.** Supply of air conditioning plant, electrical, boiler and lift equipment for Houses of Parliament, Baghdad. Documents may be had from either the architect, Mr J. Brian Cooper, 177 Corporation St, Birmingham, or consulting engineers, J. Roger Preston and Partner, 15 North Audley St, London W.1.

**1 Feb.—New Zealand.** Boiler plant required for N. Canterbury Hospital Board. B.o.T. (Ref.: ESB 16831/54).*

**8 Feb.—New Zealand.** Tenders (P and T 150/7591) invited for supply of six constant output voltage type transformers, input 190-250 V, output 230 V, single-phase, c.c., 50 c/s. Stores Div., G.P.O., Windsor Bldg, 49 Willis St, Wellington. B.o.T. (Ref.: ESB 28277/54).*

**16 Feb.—India.** Supply and erection at Periyar Power station of power transformers and outdoor switchgear. Tenders (E.199) invited by Govt. of Madras, Electricity Dept, 157 Mount Rd, Madras. B.o.T. (Ref: ESB 28180/54).*

**1 Mar.—New Zealand.** Supply of two on load tapechanging naturally cooled 15 MVA 3-phase transformers for Electricity Dept. of Dunedin City Corpn. B.o.T. (Ref.: ESB 28504/54).*

## Contracts Placed

**Barking T.C.** Sodium street lighting in Lodge Ave, Harland and Wolff Ltd., £2,659.

**Belfast T.C.** Installation in Ballygomartin intermediate school, Thomas Napier.

**Bingley (Yorks) U.D.C.** Supply and erection of 60 class B concrete columns, lamps, auxiliary gear and wiring, General Electric Co., Ltd.

**Croydon T.C.** Cables, switches, motor starters, lighting fittings, etc., at Surrey St pumping station. Buxton and Longley Ltd., £1,645.

**Edmonton T.C.** Installations on Potters Bar estate, Holliday, Hall and Stinson, £3,342.

**Enfield U.D.C.** Street lighting improvements during 1955; Edison Swan Electric Co. Ltd., £4,393; Concrete Utilities Ltd., £3,541; and Eastern Electricity Board, £1,192.

**Hartlepool T.C.** Rewiring of borough buildings, John Westmorland and Co., £1,149.

**Hull T.C.** Installation at Central Omnibus station, Alexander Shaw and Sons, £8,518.

**Ilford T.C.** Rewiring houses on Ley St. estate, B. Winters and Son, Ltd., £2,061.

**Manchester T.C.** Installation at Wythenshawe West secondary technical school, Four Cousins (Electrical Contractors) Ltd.

**North Shields.** Reorganisation of electrical system at Preston Hospital, Veale-Nixon Ltd., £3,800.

**Sheffield T.C.** Supply of two 37 kVAr capacitors and three 45 kVAr automatically controlled line units for power factor correction at Abattoir, British Insulated Callender's Cables Ltd., £1,246.

**South Shields T.C.** Supply of alternator and salient-pole synchronous motor for grammar and technical school, A. Reyrolle and Co., Ltd., £1,507.

**Stamford (Lincs) T.C.** Rewiring pre-war houses, C. Stanley Tagg Ltd., £2,237.

## Trade Notes

**New Showroom.** Dimplex Ltd. have opened new London showrooms at 17 Shepherd St, W.1. Telephone: Grosvenor 1025.

**Change of Address.** British Insulated Callender's Construction Co., Ltd., announce that the address of their Middlesbrough district office is now 55/57 Borough Rd, Middlesbrough. Telephone No. 43644. The company's branch offices at Exeter and Plymouth each have an additional telephone number. Their numbers are now Exeter 67308 and 3514 and Plymouth 60257 and 65151.

**Agents.** The Stonebridge Electrical Co., Ltd., 6 Queen Anne's Gate, London, S.W.1, have just been appointed agents for Trüb Träuber and Co., of Zurich, makers of oscillographs, electron microscopes, heat meters and various switchboard indicating and recording instruments.

# BUSINESS PROSPECTS

## Home

**Acton.** Henry White and Son Ltd., of 133 Regent St, W.1, have submitted plans for new factory in Park Royal Rd.

**Airdrie.** Approval sought for scheme for R.C. school at Burnfoot.

**Aldridge (Staffs) U.D.C.** Revised sketch plans approved for public hall. Architects are W. A. Harvey and H. G. Wicks, 119 Hagley Rd, Edgbaston. Cost estimated at £75,000. Also, H. J. Franklin, of Whinney, Son and Austen Hall, architects, 37 Norfolk St, London, W.C.2, has prepared plans for £51,000 block of shops, flats and offices off Anchor Rd.

**Ayr.** Dean of Guild Court has approved extension of premises in Dalblair Rd, for use as showroom, offices and stores by Dalblair Motors Ltd.

**Bacup T.C.** Approval sought for erection of further 54 houses on Tunstead estate.

**Barking.** Permission being sought by Dominion Sales (London) Ltd., of 6 Finsbury Sq, E.C.2, to build factory in Renwick Rd.

**Blackburn T.C.** Erection of county mixed secondary modern school at Witton Pk. Borough Engineer, Town Hall.

**Bradford.** Field, Sons and Co., Ltd., planning extensions to works and offices at Lidget Green. Plans approved.

**Chichester.** New store to be built in Chapel St by J. Sainsbury, Stamford Hse, Stamford St, London, S.E.1.

**Coventry.** It is proposed to establish an industrial estate of 40 acres on Stonebridge Highway. Building leases will probably be offered to Lea Francis Motors Ltd.: Massey, Harris and Ferguson, Ltd.; Bright Engineering Co.; and British Road Services.

**Derby T.C.** Site has been leased to Platers and Stampers Ltd., City Rd, for erection of new factory. Work expected to begin late next year.

## Gazette Announcements

### COMPANIES ACTS

**Daco Refrigeration Ltd.** Last day for receiving proofs in respect of intended payment to preferential creditors, 24 Dec. Liquidator is R. K. Clark, Official Receiver, Somerset Hse, 37 Temple St, Birmingham.

**Geo. Andrews Co., Ltd.** Meetings to take place today (16 Dec). of creditors and contributories at County Court Offices, 87 West St, Boston, at 11.30 a.m. and 12 noon resp.

### BANKRUPTCY ACTS

*Receiving Order.*

**Salford.** John G. Barrett, trading as Barrett's Electrical Installations at 134 Broad St, Pendleton, Salford. Date of receiving order, 30 Nov.

**Derby.** Charles T. Boden, trading as The High Peak Wholesale Electrical Supplies at 5 Hartington St, Derby. Receiving order dated 3 Dec.

*Dividends*

**London.** Gilbert L. Searle, electrical engineer of 309 Portobello Rd, W.10. First and final dividends of 4d. in £ payable on 23 Dec. at Bankruptcy Bldgs, Carey St, W.C.2.

*Release of Trustee*

**London.** Murdoch C. Usher, electrical contractor of 31 Ranelagh Garden Mansions, Hurlingham, S.W.6. Trustee was W. F. Cresswell, Sr. Official Receiver, Bankruptcy Bldgs, Carey St, W.C.2.

**Dewsbury.** T. Smith and Son (Dewsbury) Ltd. are to extend the Wheatcroft Mills, Batley Carr.

**Dundee.** Plans approved for extensions to Baltic works in Anisfield St of Hardie and Smith Ltd. Estimated cost is £60,000.

**Edinburgh.** New factory and warehouse to be built in Beaverhall Rd by W. and N. Duncan Ltd. Cost has been estimated at £100,000.

**Gloucester.** Approval given to erection of secondary school to serve Hucclecote-Brockworth area.

**Heanor U.D.C.** Erection of 50 houses on Godkin estate, Langley Mill. R. Archer, Engineer and Surveyor, Council Offices.

**Helensburgh (Dunbarton).** Dean of Guild Court has approved erection of 122 houses at Ardencaple Policies for the Admiralty.

**Ilford T.C.** Construction of 34 houses in Green Lane and St. Mary's Lane. Borough Engineer, Town Hall.

**Lewes (Sus.) T.C.** Tenders may soon be invited for erection of 50 dwellings on Mountford estate. This scheme will eventually provide for 14 houses, 28 maisonnettes and 106 flats.

**Leyton (Essex) T.C.** Scheme being considered for erection of 91 dwellings on Ive Farm housing site. Quantity surveyors will probably be Spriggs and Partners, 2 South Audley St, London, W.1.

**Liverpool T.C.** Application for sanction to borrow various sums for erection of and extensions to schools to be made. Among new schools envisaged are £150,150 Edge Hill secondary modern, £207,950 West Derby secondary technical, and £94,760 Princes Park secondary modern.

**London.** Designs prepared for multi-storey office block in York Rd on South Bank site, for which architects are M. C. Hughes and Partners. Approval is soon to be sought for Shell Petroleum's new 25-storey office block on South Bank site. Company's advisory architect is H. Robertson, 53 Bedford Sq, W.C.1.

**Loughborough.** Plans submitted for additions to factory and offices in Derby Rd and Regent St by Genatosan Ltd.

**Manchester.** Kodak Ltd. propose four-storey extension to photographic works in Sackville St.; architects are Matley, Brotherton and Mills, 39 Oxford Rd, Manchester.

**Mansfield (Notts).** Plans approved for new factory for Norvic Shoe Co. Ltd. of Norwich. Extra floor to be added to Redcliffe Rd factory of Forster Clay and Ward Ltd. E. C. Rippon Ltd. propose additional office premises in Moor Lane.

**Margate.** Algraphy Ltd. of Willowbrooke Grove, London, S.E.15, are to build factory on the industrial estate at Westwood.

**Middlesbrough.** Sketch plans approved by T.C. for proposed St. Anthony's R.C. secondary school. Tees Conservancy Commission to obtain tenders soon for constructional work at Lackenby. Work will cost £2¾ million; £2 million for civil engineering work and rest for cranes and equipment. Also, site preparation work to begin on second stage of Pallister Pk estate in May. Scheme provides for 694 houses, 24 three-storey flats and 20 bungalows. Actual building expected to begin in Jan. 1956.

**Middleton T.C.** Construction of 30 bungalows on various sites. G. Syddall, Borough Architect, Town Hall.

**Newcastle-on-Tyne T.C.** Cairns and Byles of 8 Osborne Rd have been appointed heating and lighting consultants for Firfield secondary school.

**Northampton.** Dallington Fields industrial estate is site for proposed factory of J. A. Perkins and Co. (Northampton) Ltd.

**Oldbury T.C.** Erection of 175 houses on Cakemore estate. Borough Surveyor, Municipal Bank Chambers, Birmingham St.

**Rayleigh (Essex).** Revised scheme submitted for erection of instalment of Swayne county secondary school. Cost estimated at £233,231.

**Rowley Regis.** Territorial Army centre proposed at Perry Park costing £80,000. Architects are W. Campbell and Son, 6 Pall Mall, Hanley, Stoke-on-Trent.

**Rugby T.C.** Plans being considered for Benn Memorial Hall, council chamber, committee rooms and offices which are estimated to cost £170,500. Architect is E. Prestwick, Bradshaw Gate Chambers, Leigh, Lancs.

**Rugeley.** Edward Pinches and Co., Ltd., to build new factory on Brereton industrial estate.

**Scarborough.** Tesseymans of Scarborough Ltd., to build new factory in Seamer Rd. Stores, offices, etc., proposed by Baird and Tatlock (London) Ltd., at 58 Lever St.: architects are Reynolds and Scott, 9 Albert Sq.

**Seaton Valley (Northumb.) U.D.C.** Allocation of 140 houses received for erection in 1955.

**Sedgley.** Layout plans approved for proposed factory at Upper Gornal for Fordham Pressings Ltd., of Wolverhampton.

**Sheffield.** Plans being prepared for factory extensions for C. and J. Hampton Ltd., Bernard Rd. Total cost estimated at £100,000.

**Stockton-on-Tees T.C.** Erection of 174 three-storey flats in Portrack Lane being planned.

**Westport (Eire) U.D.C.** Erection of 40 houses in Demesne housing scheme. R. G. Browne, Town Clerk, Council Offices.

## Overseas

**Australia.** L. D. Beeston Pty. Ltd., 387 Kent St, Sydney, are anxious to represent U.K. manufacturer of transformers of from 1,000 kVA to 10,000 kVA capacity.

**Saudi Arabia.** Basheikh and Abdulaziz Babrouk, Prince Abdulla Feisal Bldg, Jedda, are anxious to obtain agencies for wide range of goods including cables, accessories, switches, cookers, irons, radiators, etc.

**South Africa.** New agencies will be sought by Mr Ian B. McIntyre of Alan Frank Agencies, Electrical Hse, Loop St, Cape Town, who is visiting this country shortly. Electrical items in which he is interested include v.i.r. and p.v.c. flexes and cables, all electrical appliances and conduit fittings and tubing. Firms interested in meeting Mr McIntyre should contact Export Services Branch of B.o.T.

**Venezuela.** Mr Henry K. Hearn, of Recoven, S.A., Apartado 3855, Caracas, is interested in handling electrically-welded conduit tubing from the U.K. Tubing should be black lacquered inside and outside, have American thread and one coupling. Sizes in use in Venezuela are ½ in., ¾ in., 1 in., 1½ in. and 2 in.

# MEETINGS TO NOTE

**THURSDAY, 16 DEC.**

INCORP. PLANT ENGRS. (Blackburn). "Lighting," Mr Robinson of E.D.A. Golden Lion Hotel, 7.30 p.m.

INCORP. PLANT ENGRS. (Mersey and N. Wales). "Progress in Lamps and Lighting," R. V. Mills. Radiant Hse, Bold St, Liverpool, 7.15 p.m.

I.E.E. (E. Midland). Faraday lecture on "Courier to Carrier in Communications," T. B. D. Terroni. Albert Hall, Nottingham, 6.30 p.m.

I.E.E. (Southern). Annual dinner and dance at Polygon Hotel, Southampton.

I.E.E. (Irish). "New Cork Power Station—Mechanical and Electrical Plant," H. Monroe and C. V. O'Donnell. Trinity College, Dublin, 6 p.m.

CHELMSFORD ENGRNG. SOC. "Contribution of Twentieth Century Science to Modern Thought," Sir Henry Self. Social Hall of Crompton's, 7.30 p.m.

A.S.E.E. (Watford). "Industrial, Electrical and Mechanical Repairs," H. Westwood, Clarendon Hotel, Station Rd, 8 p.m.

**FRIDAY, 17 DEC.**

INCORP. PLANT ENGRS. (Birmingham). Film show. Imperial Hotel, 7.30 p.m.

INCORP. PLANT ENGRS. (North-East). Annual dinner.

ELECT. TRADES' COMMERCIAL TRAVELLERS' ASSOC. Annual stag party, dinner and smoker. The Windsor Castle (Victoria Stn), S.W.1, 6.30 p.m.

INST. OF PHYSICS. "X-Ray Fluorescence Analysis," E. F. Priestley, 47 Belgrave Sq, S.W.1, 6.30 p.m.

**SATURDAY, 18 DEC.**

MANCHESTER ASSOC. OF ENGRS. Christmas Conversazione and Dance at College of Technology.

A.S.E.E. (Oxford). "Earth Leakage Protection," J. A. Robbins, Y.M.C.A., 10 George St, 6.30 p.m.

**TUESDAY, 21 DEC.**

I.E.E. (S.E. Scotland). "Floor Warming," J. W. Maile. Carlton Hotel, Edinburgh, 7 p.m.

E.P.E.A. (S.W. Tech. Group). Christmas meeting: Any Questions.

I.E.S. (Glos and Cheltenham). "Lighting of Parks and Gardens," H. A. Turner, Cadena Cafe, High St, Cheltenham, 6.30 p.m.

I.E.E. (N. Scotland). "The Dundee Gas Turbine." E. C. Davis, Burnetts Tearooms, Academy St, Inverness, 7.30 p.m.

A.S.E.E. (London). "Variable Speed Control of Motors." J. C. Milne, Lighting Service Bureau, Savoy Hill, W.C.2, 6.30 p.m.

# TRADE MARKS

*This information is extracted from the Official Journal by permission of the Controller.*

**Tensulac.** 733,899. Class 1. Adhesives. 733,900. Class 16. Insulating materials. Berry Wiggins and Co., Ltd., Field Hse, Breams Bldg, Fetter Lane, E.C.4.

**Falks Teatime.** B 723,528. Class 9. Electric kitchen utensils. Falk Stadelmann Co., Ltd., 91 Farringdon Rd, E.C.1.

**Quad.** B 731,559. Class 9. Apparatus and instruments for the transmission and reproduction of sound. Acoustical Mfg. Co., Ltd., 30 St Peter's Rd, Huntingdon.

**Polimop.** B 733,501. Class 9. Domestic floor and furniture polishing machines. A. F. Jeffree Ltd., 8 Doversgreen Rd, Reigate.

**Visionmeter.** 733,878. Class 9. Electrical, wireless, measuring and checking apparatus and instruments. Attwood Statistics Ltd, Chantry Hse, Eccleston St, S.W.1.

# NEW COMPANIES

*Extracted from the Register issued by Jordan and Sons, Ltd., 116 Chancery Lane, W.C.2.*

**Edwards Instruments Ltd.** High vacuum engineers, manufacturers of pumps, compressors; electrical, mechanical and general engineers, etc. Nom. cap.: £100. Dirs.: not named. Subs.: F. D. Edwards, Windover, Balcombe Rd, Horley, Surrey, and F. S. B. Murrells, Tresco, Neville Ct, Tunbridge Wells.

**Edwards Vacuum Ltd.** High vacuum engineers, manufacturers of pumps, compressors, electrical, mechanical and general engineers, etc. Nom. cap.: £100. Dirs.: not named. Subs.: F. D. Edwards, Windover, Balcombe Rd, Horley, Surrey, and F. S. B. Murrells, Tresco, Neville Ct, Tunbridge Wells.

**Errington Electrical Ltd.** 84 Tolmers Rd, Cuffley, Herts. Manufacturers of and dealers in electrical and mechanical apparatus and accessories; wireless and television sets, etc. Nom. cap.: £500. Dirs.: J. E. Clennell, F. D. Whiting and Kathleen M. Clennell.

**Harold Plant Ltd.** 42 Park Rd, Peterborough. Agents for the sale of and dealers in artificial lighting apparatus, electrical plant and machinery, wireless and television sets, etc. Nom. cap.: £10,000. Dirs.: H. A. Plant and F. Jarrett. Subs.: H. A. Plant and Mary D. Plant, Greenwards, Markholm Rd, Peterborough.

**Tappelectric Ltd.** Druid Hall, Bristol 9. Electrical engineers and general electric installation contractors, lighting specialists and contractors, wireless engineers, etc. Nom. cap.: £1,000. Dir.: R. E. Tappenden.

**Ronald Jeffs Ltd.** 61 New Kings Rd, Fulham, S.W.6. To take over business of radio and electrical engineer carried on as "Ronald Jeffs" at 400 Lillie Rd, and 61 New Kings Rd, Fulham, S.W. Nom. cap.: £1,000. Permt. dirs.: J. H. Boots and Mrs A. M. Boots.

**Industrial Belt and Screen Co., Ltd.** 94 Baker St, W.1. Electrical, mining, chemical, civil, mechanical and general engineers and contractors, etc. Nom. cap.: £100. Dir.: J. H. Abisch.

**Gregory's Radio Ltd.** 19 Market Place, Wells, Som. To take over business of radio and television retailers, wholesalers and factors, electrical engineers and repairers carried on as "Gregory's Radio" at Wells, Som. Nom. cap.: £10,000. Dirs.: W. C. H. Gregory and E. A. F. Gregory.

**C. W. Thompson (Construction) Ltd.** Electrical, mechanical, structural and power plant engineers, etc. Nom. cap.: £100. Dirs.: L. P. Callender, 6 Westbrook Av, West Hartlepool, Co Durham, and D. E. Edminson, 25 Beechwood Av, Gateshead-on-Tyne.

**Robert Cupitt Ltd.** 31-3 High Holborn, W.C.1. Power transmission, oil refinery and mechanical and general engineers, etc. Nom. cap.: £100. Dirs.: R. Cupitt and Mrs N. Cupitt.

**Henry W. Lawton Ltd.** 104 Dudley Rd East, Oldbury, Worcs, General, agricultural, mechanical, electrical, hydraulic and pneumatic engineers, etc. Nom. cap.: £10,000. Dirs.: H. W. Lawton and Mrs E. M. Lawton.

**Intertechnical Agencies Ltd.** Engineers, founders, smiths, machinists, electricians, mechanical engineers and manufacturers and workers of and dealers in electrical and mechanical apparatus and goods, etc. Nom. cap.: £100. Dirs.: not named. Subs.: J. F. Beer, 6 Wardrobe Place, Carter Lane, E.C.4; and Marjorie L. L. Schafer, 274 Rosley Lane, N.17.

**James Earthrowl and Co., Ltd.,** Walton Hse, 1 Newman St, W.1. Agents for the importation, exportation, purchase and sale of merchandise; manufacturers of and dealers in electrical and mechanical apparatus, etc. Nom. cap.: £100. H. W. Earthrowl signs as director.

**Hugh Simmons Group Ltd.,** 44/6 Theobalds Rd, W.C.1. Consulting engineers, wholesalers, retailers, importers and exporters of and dealers in motor vehicles, tractor, electrical, wireless, television and telephone parts and accessories, etc. Nom. cap.: £10,000. Dirs.: to be appointed by subs. Subs.: P. J. Esnouf, 26 Kirkstall Gdns, Streatham Hill, S.W.2; and G. E. Malyon, Rodings, Roding Lane, Chigwell.

**Brown Finance Co., Ltd.,** 71 High St, Southend-on-Sea. Financiers for the sale for cash or on credit or hire purchase of motor cars, radio and electrical apparatus, etc. Nom. cap.: £100. Dirs.: Peggy R. Brown and T. B. Brown.

**P.H.E. Ltd.** Kings Hse, 42 King St West, Manchester. General, motor, mechanical, electrical, oil fuel, marine, civil and consulting engineers, etc. Nom. cap.: £2,000. Dirs.: H. W. Harris and T. W. Smith.

**Sapav (London) Ltd.** 27 Hertford St, W.1. Importers, exporters, buyers and sellers of and dealers in film projectors, cameras, optical, scientific and musical instruments, electrical devices, etc. Nom. cap.: £1,000. J. D. P. Williams signs as director.

**F. J. Roberts and Co. (Bexleyheath) Ltd.,** 48 Windmill St, Gravesend, Kent. Mechanical, agricultural, electrical, motor, oil fuel and constructional engineers, etc. Nom. cap.: £100. Dirs.: F. J. Roberts and Alice L. Roberts.

**G. Barnes Ltd.** 11 Penn Rd, Hazlemere, High Wycombe, Bucks. Electrical engineers, builders, contractors, etc. Nom. cap.: £1,500. Dirs.: G. F. Barnes, Violet Barnes and A. M. Gravestock.

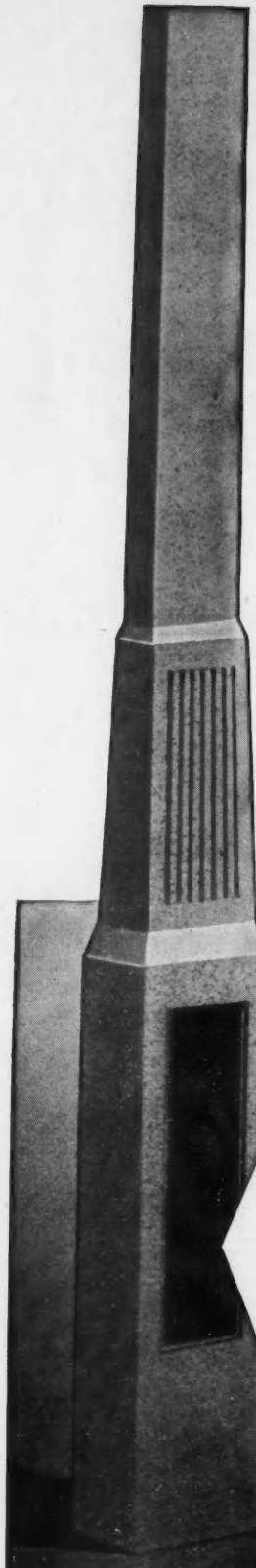
**Chapel Developments Ltd.** Manufacturers of and dealers in electronic discharge vessels and tubes, neon illumination signs, etc. Nom. cap.: £1,000. Dirs.: N. Brindle, 4 Nursery Rd, Prestwich, Manchester; C. F. Cross, 44 Poppythorne Lane, Manchester; and A. Storey, 13 Highfield Rd, Prestwich, Manchester.

**Press-Knives and Plant Ltd.,** 40 Broadway, Westminster, S.W.1. Mechanical, electrical and general engineers, etc. Nom. cap.: £1,000. Dir.: J. Stanger.

**Norman Bowker (Electric House) Ltd.,** 8 Longsight Rd, Holcombe Brook, nr. Bury. To take over business of electrical dealer and wireless and radio engineer carried on at Holcombe Brook, and at 20 Bridge St, Ramsbottom, Lancs. Nom. cap.: £1,000. Permanent dirs.: W. N. Bowker and J. Duckworth.

*Company limited by guarantee without share capital.*

**Society of X-ray Technology, Ltd.** Income and property of society, whencesoever derived, shall be applied solely towards promotion of its objects. Council: W. E. Schall, hon. president, 2 Hillcroft Av, Purley; J. Mentasti, 30 Tierney Rd, S.W.2, R. L. H. Ewin, 45 Court Hse Rd, N.12, F. Carpenter, R. A. Beaven, R. L. Taylor, W. E. L. Gladwish, J. R. Taylor, A. J. Minns and A. S. Williamson.



HENLEY

# IRONCLAD SERVICE FUSES

DOUBLE-POLE

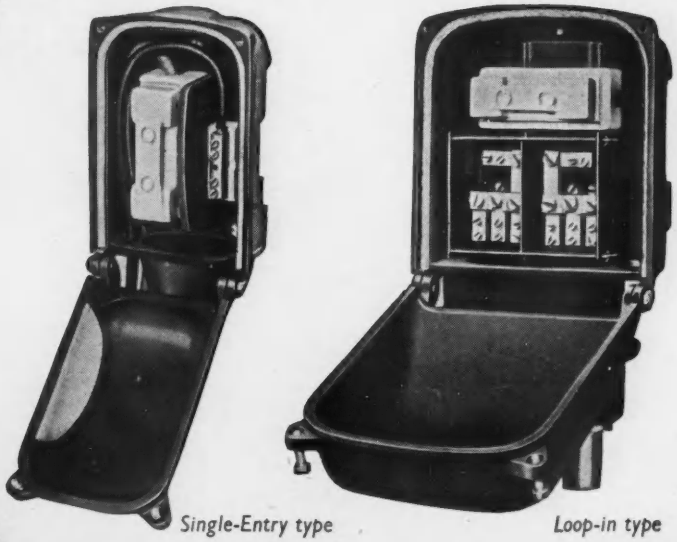
**for use in lighting columns**

These HENLEY Ironclad Service Fuses are designed specially for use in columns for outdoor lighting installations. Both are fitted with a fuse and neutral and suitable for maximum working current of 15 amp. The fuse can be supplied suitable for cartridge fuse-links or, alternatively, for wire fuse-elements.

**STREET LIGHTING · FACTORY YARDS**
**CAR PARKS · RACETRACKS · FAIR GROUNDS**
**EXHIBITIONS · SPORTS ARENAS · FLOODLIGHTING**

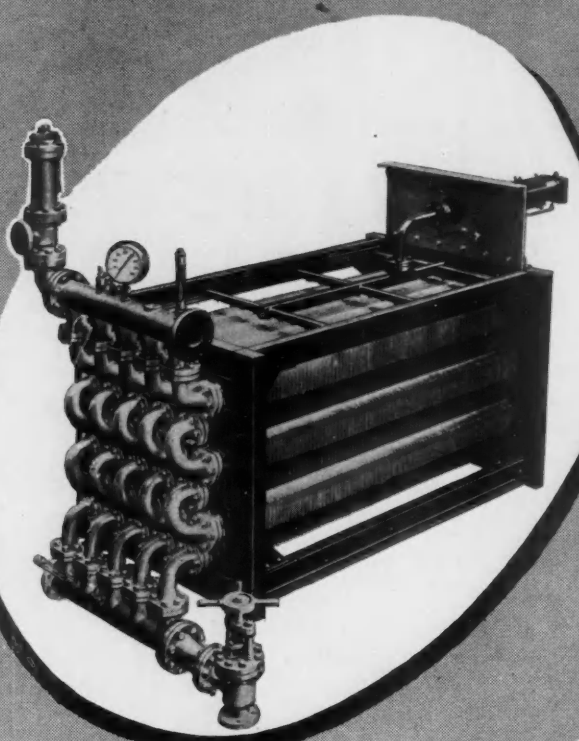
*Compact · Robust*

***Write for Folder 49/A***



*Single-Entry type* *Loop-in type*

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD. 51-53 HATTON GARDEN, LONDON, E.C.1

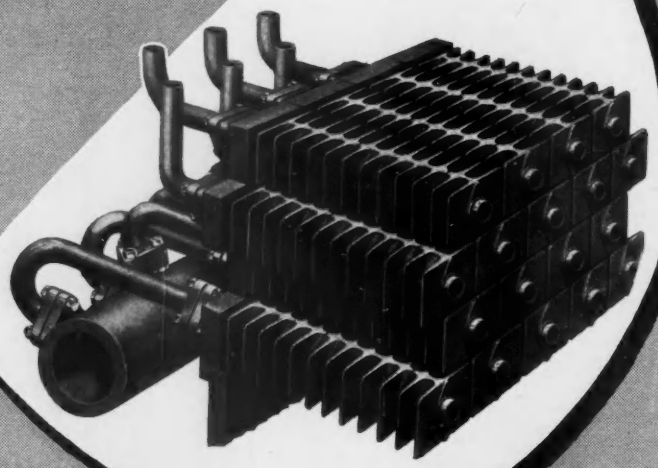


**PREMIER DIAMOND TYPE 25**

The Green's Premier Diamond Economiser for medium pressure installations up to about 650 p.s.i. Gives extended heating surface in compact dimensions, with complete facility for cleaning and inspection of every part.

**PREMIER DIAMOND STEEL TUBE**

The Green's Premier Diamond Steel Tube Economiser for highest pressures, with cast-iron gilled sleeves shrunk on steel tubes to provide the heating surface. Like all Green's Economisers, this type affords ready accessibility for cleaning and inspection as it is arranged in shallow tiers. Also in all-welded construction.



# GREEN'S ECONOMISER

E. GREEN & SON LTD · WAKEFIELD

*Makers of economisers for over one hundred years.*

G.E.135

# CLASSIFIED ADVERTISEMENTS

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 32s. 6d. per inch, and all other classified advertisements at 2s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

## TENDERS INVITED

### CRAWLEY PARISH COUNCIL

LIGHTING EQUIPMENT FOR A.23—LONDON TO BRIGHTON TRUNK ROAD

TENDERS are invited for the supply and delivery to Crawley of 18—25 ft concrete columns and 18—5 ft fluorescent lanterns. Documents may be obtained from the Clerk, Robinson Hse, Robinson Rd, Crawley, Sussex. (P 180)

### ILFRACOMBE URBAN DISTRICT COUNCIL

STREET LIGHTING

THE Council invite Tenders for the supply and erection of 145 Concrete Columns Group A Standard and the supply and fitting 73 Fluorescent Lanterns and 72 Sodium Lanterns and ancillary equipment together with the removal of existing Columns.

Specifications may be obtained from the Engineer and Surveyor, Council Offices, Ilfracombe, on payment of two guineas which will be refunded on receipt of bona-fide Tender.

Plans and general conditions of contract may be inspected at the Engineer's Office.

Tenders in plain sealed envelopes endorsed "Street Lighting" without mark or indication of the sender must be delivered to me not later than 12 noon on 18 Jan., 1955.

The Council do not bind themselves to accept the lowest or any Tender.

R. H. STEVENS,
Clerk of the Council.

Council Offices,
Ilfracombe.
11 Dec., 1954. (P 219)

### WHISTON PARISH COUNCIL

STREET LIGHTING
LIVERPOOL-WARRINGTON TRUNK RD (A57)

THE Parish Council invite tenders for the proposed supply, erection, and commissioning of sodium vapour discharge lighting units on the Liverpool/Warrington Trunk Road A.57, within the Parish District, for approximately 780 yds. The drawings and general conditions of contract may be inspected at the Liverpool City Lighting Department, 17 Highfield St, Liverpool 3, and copies of the special conditions of contract, specification, and form of tender, may be obtained from the Clerk, Whiston Parish Council, 38 Ford Rd, Whiston, Prescot, Lancs, on payment of a deposit of two guineas, which will be refunded on the submission of a bona fide tender.

Tenders in a plain sealed envelope are to be addressed to the Clerk of the Council at 38 Ford Rd, Whiston, not later than 16 Jan., 1955. The Council do not bind themselves to accept the lowest or any tender.

J. N. BEESLEY,
Clerk to the Council.

38 Ford Rd,
Whiston. (P 218)

**Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2.**

## APPOINTMENTS VACANT

*Engagement of persons must be made through a Local Labour Office or Scheduled Employment Agency, if the applicant is a man aged 18-64, or a woman aged 18-59; unless the person concerned is excepted or the employment is in a managerial or professional capacity, or it otherwise excepted from the provisions of the Notification of Vacancies Order, 1952.*

### THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF METER REPAIRER (MECHANICIAN)—PRESTON

RATE of pay: 45d. per hour. N.J.I.C. Conditions.

Applications to the Manager, No. 4 Sub-Area, The North Western Electricity Board, 40/41 Lune St, Preston, by 29 Dec., 1954. (P 200)

### MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments, which are superannuable and subject to medical examination, in the Board's No. 4 Sub-Area:

(*a*) SECTION ENGINEER based on Newtown. Salary £715/£760 per annum (N.J.B. Class E, Grade 7).

(*b*) SECTION ENGINEER based on Welshpool. Salary £715/£760 per annum (N.J.B. Grade E, Class 7).

Applicants for posts (*a*) and (*b*) should have had experience in all branches of work associated with design, construction and operation of E.H.T., H.T., and L.T. overhead and underground distribution systems, including indoor and outdoor substation equipment.

(*c*) ASSISTANT SECTION ENGINEER based on Welshpool. Salary £635/£680 per annum (N.J.B. Class E, Grade 9).

(*d*) ASSISTANT SECTION ENGINEER based on Oswestry. Salary £635/£680 per annum (N.J.B. Class E, Grade 9).

Applicants for posts (*c*) and (*d*) should have had experience of H.V. and M.V. overhead and underground distribution work.

(*e*) GENERAL ASSISTANT ENGINEER (CONSTRUCTION) based on Llandudno Junction. Salary £675/£720 per annum (N.J.B. Class J, Grade 12).

Applicants should have had experience in the laying out, erecting and setting to work of overhead and underground mains, mainly in rural areas, and the control of gangs engaged on such work.

(*f*) GENERAL ASSISTANT ENGINEER in the Technical Section based on Legacy, near Wrexham. Salary £635/£680 per annum (N.J.B. Class J, Grade 13).

Applicants should have had experience of all forms of electrical metering and metering equipment, including installation.

Applicants for all posts should preferably have the qualifications necessary to enable them to become Chartered Electrical Engineers.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity House, Rhostyllen, near Wrexham.

Closing date: 28 Dec., 1954. (P 194)

### MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments, which are superannuable and subject to medical examination in the Board's No. 2 Sub-Area.

(*a*) DISTRICT ENGINEER in the Runcorn District. Salary £1,035/£1,125 per annum (N.J.B. Class F, Grade 2).

Applicants should be Chartered Electrical Engineers and have had considerable experience in the operation and maintenance of networks up to 33 kV in an industrial area.

(*b*) THIRD ASSISTANT ENGINEER (CONSTRUCTION) at the No. 2 Sub-Area Headquarters, Sandiway Hse, near Northwich. Salary £790/£850 per annum (N.J.B. Class K, Grade 10).

Applicants should have had experience in overhead and underground distribution work.

(*c*) GENERAL ASSISTANT ENGINEER (PLANNING) at the No. 2 Sub-Area Headquarters, Sandiway Hse, near Northwich. Salary £675/£720 per annum (N.J.B. Class K, Grade 13).

Applicants should have had experience in overhead and underground distribution work.

(*d*) ASSISTANT SECTION ENGINEER in the Runcorn District. Salary £675/£720 per annum (N.J.B. Class F, Grade 9).

Applicants should have had experience in H.T. and L.T. overhead and underground distribution work.

(*e*) COMMERCIAL ASSISTANT (TECHNICAL) in the Runcorn District. Salary £595/£640 per annum (N.J.B. Class F, Grade 11).

Applicants must have had an engineering training. The duties will be to advise consumers on supply, tariffs and installation matters.

Applicants for posts (*b*), (*c*), (*d*) and (*e*) should preferably have the qualifications necessary to enable them to become Chartered Electrical Engineers.

(*f*) DRAWING OFFICE ASSISTANT (MALE) in the Warrington District. Salary within the range £170/£395 p.a. according to age, rising subject to satisfactory and competent service to £470 per annum.

Applicants should be in possession of the General Certificate of Education, and preferably have had previous drawing office experience.

Application forms for all posts are available from the Manager No. 2 Sub-Area, Sandiway Hse, near Northwich, Cheshire.

Closing date: 28 Dec., 1954. (P 193)

### SOUTH WALES ELECTRICITY BOARD

REQUIRED GENERAL ASSISTANT ENGINEER in the Central Sub-Area of the Board at Cardiff.

Salary—Class K, Grade 13 (£675 by £15—£720) of N.J.B. Schedule.

Applications stating age, present position and salary, qualifications, experience and three referees, to be addressed to the Secretary to arrive by 31 Dec., 1954.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (P 176)

### LONDON ELECTRICITY BOARD

ENGINEERING DRAUGHTSMEN

APPLICATIONS are invited for the above positions in the South Eastern Sub-Area based at Woolwich, S.E.18.

Candidates should have had a good general and technical education and be experienced in one or more of the following subjects: drawing office routine, electrical diagrams, obtaining and recording all mains work and plant layout in transformer chambers.

The posts are graded under Schedule "D" of the National Joint Board Agreement as Grade 6, £535. 10s. to £661. 10s. per annum, inclusive of London Allowance.

Application forms obtainable from Personnel Officer, 46 New Broad St, E.C.2, to be returned completed by 31 Dec., 1954. Please enclose addressed envelope and quote ref.: V/1842/T on envelope and all correspondence. (P 192)

## BRITISH ELECTRICITY AUTHORITY
### Eastern Division

APPLICATIONS are invited for the posts of:

SHIFT CHARGE ENGINEER
NORWICH GENERATING STATION

Salary Class F, Grade 7, £755 x £15—£800 per annum.

Applicants should have served an apprenticeship and obtained a Higher National Certificate in Electrical and/or Mechanical Engineering or equivalent and possess experience in the operation of Generating Stations.

JUNIOR ENGINEER
NORWICH GENERATING STATION

Salary Class F, Grade 14, £475 x £15—£520 per annum.

The duties of the successful applicant will include assisting in the Control Room on shift and other operation and investigation duties. Preference will be given to applicants who have had previous experience in a Generating Station and who have reached the standard of the Ordinary National Certificate in Electrical Engineering or its equivalent.

Applications stating age, qualifications and experience should be sent to the Controller, British Electricity Authority, Eastern Division, Northmet House, Southgate, N.14, by 1 Jan., 1955.

W. N. C. CLINCH,
Controller.
(P 201)

## YORKSHIRE ELECTRICITY BOARD
### No. 1 (Bradford) Sub-Area

Bradford District
THIRD ASSISTANT DISTRICT ENGINEER

APPLICANTS should have passed the Graduateship Examination of the Institution of Electrical Engineers or hold recognised equivalent technical qualifications, have substantial experience in construction, operation and maintenance of high voltage systems, underground cables and overhead lines and substations, and medium and low voltage networks, preferably including direct current systems.

Candidates must be prepared to reside in the district and undertake standby duties, if required.

Salary—N.J.B. Class J, Grade 9, £790/£20/£850 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 1 (Bradford) Sub-Area, Yorkshire Electricity Board, 45-53 Sunbridge Rd, Bradford, not later than 30 Dec., 1954.

### No. 6 (Hull) Sub-Area

Bridlington District
SECOND ASSISTANT DISTRICT ENGINEER

Applicants should have sound practical experience in the operation, maintenance, planning and construction of H.V. and L.V. underground and overhead lines and substations in an extensive urban and rural area.

Preference will be given to candidates who are Corporate Members of the Institution of Electrical Engineers or possess equivalent qualifications.

The successful candidate will be required to undertake standby duties and to reside in Bridlington.

Salary—N.J.B. Class D, Grade 7, £675/£15/£720 per annum.

Hull and Bridlington Districts
JUNIOR ENGINEERS

Applicants should hold the Higher National Certificate in Electrical Engineering, or equivalent qualifications, and have had training in the construction, operation and maintenance of H.V. and L.V. overhead and underground Distribution Systems.

The successful candidates will be required to reside in the district to which they are appointed, and may be required to carry out standby duty.

Hull District (Hull)

Salary—N.J.B. Class J, Grade 17, £475/£15/£520 per annum.

Bridlington District (Driffield)

Salary—N.J.B. Class D, Grade 12, £475/£15/£520 per annum.

continued in next column

continued from previous column

Applications, giving full details of age, qualifications and experience, together with the names of two referees should be forwarded to the Manager, No. 6 (Hull) Sub-Area, Yorkshire Electricity Board, Ferensway, Kingston-upon-Hull, not later than 30 Dec., 1954.

### No. 5 (Wakefield) Sub-Area

Castleford, Barnsley, Wakefield and Doncaster Districts
GENERAL ASSISTANT DISTRICT ENGINEER

Applicants must have had a sound practical training with experience in the construction, operation and maintenance of H.V. and M.V. overhead and underground distribution networks, substation plant and ancillary equipment.

Applicants must hold a current driving licence, be prepared to reside in the district, and undertake standby duties.

Applicants must hold at least a Higher National Certificate in Electrical Engineering.

Salary—N.J.B. Class F, Grade 11, £595/£15/£640 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 5 (Wakefield) Sub-Area, Yorkshire Electricity Board, 1a Denby Dale Rd, Wakefield, not later than 30 Dec., 1954.

### No. 7 (Grimsby) Sub-Area

Scunthorpe District
JUNIOR ENGINEER

Applicants should hold the Higher National Certificate in Electrical Engineering or an equivalent qualification, and have had training and experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems.

Salary—N.J.B. Class F, Grade 14, £475/£15/£520 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Rd, Grimsby, not later than 30 Dec., 1954.

### No. 4 (Leeds) Sub-Area

JUNIOR ENGINEER (COMMERCIAL)

Applicants should have had a sound technical and practical training and be competent to advise consumers in all matters regarding the utilisation of electricity. They should be familiar with the I.E.E. and Supply Regulations and be in possession of the Higher National Certificate in Electrical Engineering or an equivalent qualification.

Salary—N.J.B. Class J, Grade 17, £475/£15/£520 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 4 (Leeds) Sub-Area, Yorkshire Electricity Board, Bramhope, near Leeds, not later than 30 Dec., 1954. (P 202)

## LONDON ELECTRICITY BOARD
PRINCIPAL ASSISTANT

APPLICATIONS are invited for the above position in the Internal Audit Section of the Chief Accountant's Department.

Candidates should have had experience of the audit of large undertakings, and should have recognised accountancy qualifications. Experience in the Electricity Supply Industry is desirable but not essential.

The post is graded within the National Joint Council agreement (Administrative and Clerical Grades) as Grade 9, i.e. £1,000/£1,120 per annum, plus the appropriate London Area Allowance.

The successful candidate will be based at 46 New Broad St, E.C.2, but will be required to work anywhere within the London Board area.

Application forms obtainable from Personnel Officer, 46 New Broad St. E.C.2, to be returned completed by 29 Dec., 1954. Please enclose addressed envelope and quote Ref.: V/1863/T on envelope and all correspondence. (P 224)

## CENTRAL ELECTRICITY BOARD
### Malaya

MECHANICAL ENGINEER required by the above Board. Salary scale (including expatriation pay and present temporary allowance at rate for single men) equivalent to £1,197 rising to £2,100 a year. Commencing salary according to qualifications and experience. Additional temporary allowances totalling £210/£399 a year (married men) and £301/£630 (family men). Option of appointment either (*a*) on agreement for three years with prospect of permanency or (*b*) on contract for three years with gratuity of £200 or £280 for each year's service according to salary. Opportunity of terminating appointment after one year's service. Free passages. Liberal leave on full salary. Candidates must have served an apprenticeship with a firm of diesel engine manufacturers and have had not less than five years' experience on erection and/or maintenance of engines and power plant. They should have a knowledge of AC electrical generators of types normally driven by diesel prime movers. Preference will be given to candidates possessing a first class M.O.T. Diesel Certificate. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/30065/EE. (P 223)

## SOUTHERN ELECTRICITY BOARD
INSTALLATION ENGINEER

SWINDON District of No. 2 (Newbury) Sub-Area. Salary N.J.B. Class F, Grade 8, Column 1 (£715 by £15—£760 per annum). N.J.B. Conditions of Service.

Applicants should be qualified to accept responsibility for all installation and maintenance work in the District and Branches and to collaborate with the Development Engineer and District Commercial Engineer in the preparation of estimates for contracting work, particularly those of an exceptional nature. The duties will also extend to Branches.

The successful candidate will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him in envelopes suitably endorsed, not later than 31 Dec., 1954.

DEMONSTRATOR

Swindon District of No. 2 (Newbury) Sub-Area. Salary N.J.C. Grade 1 (£400/£490 per annum). N.J.C. Conditions of Service.

Applicants should be women who are qualified to advise generally on the utilisation of electric domestic appliances, to give public demonstrations of apparatus and to assist in showroom duties. The possession of an E.A.W. Certificate or equivalent Domestic Science qualification would be an advantage.

The successful candidate will be required to contribute to the B.E.A. and Area Boards' Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him in envelopes suitably endorsed, not later than 31 Dec., 1954. (P 214)

## MIDLANDS ELECTRICITY BOARD

THIRD ASSISTANT DISTRICT COMMERCIAL ENGINEER required in the Kidderminster District of the Worcester and District Sub-Area. Duties will include advising consumers in respect of electrical equipment, estimating and contracting work, etc. Experience of D.C./A.C. Changeover would be an advantage. Technical qualifications desirable.

Salary £635/£680 per annum (N.J.B. Class F, Grade 10), Superannuable.

Apply in writing, within 14 days stating age, experience, present salary and position to Mr R. Mallet, Sub-Area Manager, Midlands Electricity Board, Whittington, Worcester.

A. STEPHENS,
Secretary.
(P 225)

## BRITISH ELECTRICITY AUTHORITY
### South Wales Division

Vacancy No. 120/54

APPLICATIONS are invited for superannuable N.J.B. appointment of GENERAL ASSISTANT ENGINEERS, Technical Department, Divisional Headquarters. Salary AX/CX6, £600/£765 per annum. H.N.C. or equivalent qualifications desirable.

GENERAL SECTION

Commissioning, maintenance and fault investigation of protective gear and electrical plant in generating stations and 132 kV substations.

SYSTEM DEVELOPMENT SECTION

Assist in design of 132 kV transmission system and investigation of a wide range of system problems.

MEASUREMENT SECTION

Applicants should be familiar with the use of potentiometer equipment and standardisation of indicating instruments; experience in calibration of electrical instruments and polyphase integrating meters.

Application forms obtainable from Secretary, South Wales Division British Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, to be returned by 31 Dec., 1954. (P 228)

## THE NORTH WESTERN ELECTRICITY BOARD

APPOINTMENT OF
SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER (SALES SUPERINTENDENT)
WEST DISTRICT (STRETFORD)

THE successful applicant will be required to assist the District Commercial Engineer in all normal sales activities. He will be responsible for supervising the organisation of Service Centres, exhibitions and publicity and the work of outdoor and indoor sales personnel.

Preference will be given to applicants who are Corporate Members of the Institution of Electrical Engineers or possess equivalent qualifications.

Salary Scale: £755 by £15—£800 p.a. Grade F.7, N.J.B. Conditions.

APPOINTMENT OF
ENGINEERING DRAUGHTSMAN (ELECTRICAL)
SUB-AREA TECHNICAL ENGINEER'S DEPARTMENT, MANCHESTER

Applicants should have had a good technical training and drawing office experience in the electrical design, layout and detailing of indoor and outdoor substations, up to and including 33,000 V, together with the preparation of protective system schematic and wiring diagrams.

Salary within the range £510 by £20—£630 p.a. according to qualifications and experience. Schedule D, Grade 6, N.J.B. Conditions.

Applications for the above posts to Sub-Area Secretary, No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, P.O. Box 493 by 29 Dec., 1954.

APPOINTMENT OF
SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER (SALES SUPERINTENDENT)
CHORLEY

The successful applicant will be required to assist the District Commercial Engineer in all normal sales activities. He will be responsible for supervising the organisation of Service Centres, exhibitions and publicity and the work of outdoor and indoor sales personnel.

Preference will be given to applicants who are Corporate Members of the Institution of Electrical Engineers or possess equivalent qualifications.

Salary Scale: £755 by £15—£800 p.a. Grade F.7, N.J.B. Conditions.

Applications to the Manager, No. 4 Sub-Area, The North Western Electricity Board, 40/41, Lune St, Preston, by 29 Dec., 1954.

APPOINTMENT OF
THIRD ASSISTANT DISTRICT ENGINEER, BLACKBURN DISTRICT

The successful candidate will be required to assist in the operation, maintenance and construction of underground and overhead mains, substations and transformers, and to undertake general mains standby duties.

Preference given to candidates who are Graduate Members of the Institution of Electrical Engineers, or who possess the H.N.C. in Electrical Engineering.

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Salary Scale: £715 by £15—£760 p.a. Grade G.9. N.J.B. Conditions.

Applications to Sub-Area Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee St, Blackburn, by 29 Dec., 1954.

APPOINTMENT OF
SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER, PENRITH DISTRICT

Duties will be to assist the District Commercial Engineer in dealing with Consumers' requirements and enquiries on all matters including sale and installation of apparatus, repairs and maintenance, emergency service and tariffs, new supplies and development in urban and rural areas, control of workshops and service centres, and preparation of specifications and estimates.

Salary Scale: £675 by £15—£720 p.a. Grade D.7, N.J.B. Conditions.

Applications to Sub-Area Manager, No. 6 Sub-Area, The North Western Electricity Board, Castle Green, Kendal, by 29 Dec., 1954.

APPOINTMENT OF
THIRD ASSISTANT DISTRICT ENGINEER, NEW MILLS

Applicants should have had experience in operation and maintenance of underground and overhead networks, estimating of schemes, supervising installation of short services, preliminary surveying and assisting in routine overhead lines and preparing profiles.

Salary Scale: £635 by £15—£680 p.a. Grade E.9. N.J.B. Conditions.

Application forms can be obtained from the Sub-Area Manager, No. 7 Sub-Area, The North Western Electricity Board, Chapel St, Hazel Grove, Cheshire, and must be returned to him by 29 Dec., 1954. (P 178)

## BRITISH ELECTRICITY AUTHORITY
### East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

JUNIOR ENGINEERS,
FREEMEN'S MEADOW POWER STATION, LEICESTER
Vacancy No. 185/54/ET

Some experience in Control Room and Boiler House work in a large P.F. Station is required. Technical qualifications up to H.N.C.

Salary in accordance with Class H, Grade 16 (£475 by £15—£520 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 23 Dec., 1954.

SHIFT CHARGE ENGINEER,
AVON POWER STATION, WARWICK
Vacancy No. 186/54/ET

Applicants should be suitably qualified and have had experience in the operation of modern boiler and turbine plant.

Salary in accordance with Class E, Grade 7 (£715 by £15—£760 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 30 Dec., 1954.

These appointments will be pensionable within the terms and provisions of the British Electricity Authority and Area Boards Superannuation Scheme.

Applications should be submitted on the official form A.E.6/ACT which may be obtained from the Divisional Establishments Officer, British Electricity Authority, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated. Please quote Vacancy No.

L. F. JEFFREY,
Divisional Controller.

10 Dec., 1954. (P 215)

## BRITISH ELECTRICITY AUTHORITY
### North West, Merseyside & N. Wales Division

VACANCY NO. 242/54/T—STATION SHIFT CONTROL ENGINEER, Wigan Generating Station. Salary £555 by £15—£600 (D.10). Closing date 27 Dec.

Vacancy No. 244/54/T — STATION CHEMIST, Carlisle Generating Station. Salary £755 by £15—£800 (F.7). Closing date 5 Jan.

Applications, quoting Vacancy No. to Controller, British Electricity Hse, 825 Wilmslow Rd, Manchester 20. (P 222)

## UGANDA ELECTRICITY BOARD

APPLICATIONS are invited for permanent posts overseas as ASSISTANT ELECTRICAL ENGINEERS to meet the growth of the Board's system.

Applicants for all appointments should be Corporate Members of the Institution of Electrical Engineers or have technical qualifications leading to that status. Posts are vacant for those with considerable experience and for those with less and, in the latter case, Graduates and Students would be eligible.

Salaries according to age and experience will be in the scale £990 x £30 to £1,260 per annum.

Uganda has a pleasant climate, income tax is moderate and the salaries which have just been revised are very reasonable in relation to the cost of living. Free passages, partly furnished accommodation, medical and dental treatment. Vacation leave on full pay after three years' service.

Application forms and further information may be obtained from The London Representative, Uganda Electricity Board, 27 Regent St, London, S.W.1.

Closing date for applications, 31 Dec., 1954.

C. R. WESTLAKE,
Chairman.
(P 199)

## BRITISH ELECTRICITY AUTHORITY
### Southern Division

invites applications for the post as:

SENIOR ASSISTANT,
EDUCATION AND TRAINING SECTION, DIVISIONAL SECRETARY'S DEPARTMENT

Duties will include assisting the Education and Training Officer with training schemes for engineering and non-engineering staff and practical experience of this work is desirable. A knowledge of the requirements for membership of appropriate professional institutions and the ability to advise employees on part-time study courses will be an advantage.

Applicants should preferably possess a University degree or appropriate professional qualification.

Salary N.J.C. Grade 4, £605/£665.

Special application forms, obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, should be returned by 30 Dec., 1954. Please quote reference D.T. (P 226)

## SOUTH WALES ELECTRICITY BOARD

REQUIRED ASSISTANT, Commercial Department, District 462 (Newport), Eastern Sub-Area.

Successful applicant will be responsible to the District Commercial Manager for all domestic apparatus sales activities in the whole of the district.

Salary—Grade 4 (£605/£665) of N.J.C. Schedule.

Applications stating age, present position and salary, qualifications, experience and three referees, to be addressed to the Secretary to arrive by 31 Dec., 1954.

D. G. DODDS,
Secretary.

St. Mellons,
Cardiff. (P 177)

## BRITISH ELECTRICITY AUTHORITY
### Southern Division

APPLICATIONS are invited for the following post:

MAINTENANCE ENGINEER (MECHANICAL)
SOUTHAMPTON GENERATING STATION
S/13.598

Applicants should have experience in the maintenance of modern generating station plant and be capable of taking control of maintenance staff, and supervising turbine and boiler overhauls. Preference will be given to those possessing qualifications leading to Corporate Membership of a recognised professional institution.

Salary N.J.B. F/7, £755 by £15—£800.

Special application forms obtainable from P. D. A. Oliver, Divisional Secretary, 111 High St, Portsmouth, should be returned by 28 Dec., 1954. Please quote reference E.T. (P 227)

## EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following vacancies:

**Fens Sub-Area**

SERVICE CENTRE SUPERVISOR, PETERBOROUGH

178/54.R.

Candidates should be capable of taking charge of a Service Centre, controlling all staff employed therein and handling Consumers' enquiries efficiently. They should have had extensive sales and consumer service experience, and possess a thorough knowledge of appliances and their uses, contracting and the application of standard tariffs. The possession of a recognised professional qualification would be an advantage.

Salary will be in accordance with Grade 5 (£670 by £20—£730) of the National Joint Council Salary Agreement, commencing at a point dependent upon the successful candidate's experience and ability.

Apply to the Manager, Fens Sub-Area, Eastern Electricity Board, Milton Hall, Milton, Cambridge.

**Northmet Sub-Area**

GENERAL ASSISTANT ENGINEERS
(i) HARROW DISTRICT (REF. 511)

179/54.R.

(ii) EDMONTON DISTRICT (REF. 513)

180/54.R.

Candidates should have had a sound technical training and experience in the construction, operation and maintenance of H.V. and L.V. distribution systems, including substations.

Salary for both appointments will be in accordance with Class F, Grade 11 of the National Joint Board Salary Agreement commencing at £595 plus London Allowance.

Apply as follows:

(i) The District Manager, Eastern Electricity Board, 4 College Rd, Harrow, Middx.

(ii) The District Manager, Eastern Electricity Board, 305 Fore St, Edmonton, London, N.9.

Future salaries and conditions of service for all these appointments will be in accordance with agreements made from time to time by the appropriate negotiating bodies.

The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Applications by letter, stating age, education, qualifications and experience, with details of present appointment and salary, should be submitted to the Manager concerned within 14 days of the appearance of this advertisement. (P 216)

## BRITISH ELECTRICITY AUTHORITY

**South Wales Division**

APPLICATIONS are invited for the following superannuable N.J.B. appointments:

JUNIOR ENGINEERS

Vacancy No. 117/54

Salary of £475/£520 per annum with scope for advancement to higher operational/maintenance posts. H.N.C. or equivalent and previous manufacturing works training essential.

GENERATION (CONSTRUCTION) DEPT.
GENERAL ASSISTANT ENGINEERS,

Vacancy No. 118/54

Applicants should have a knowledge of Mechanical or Electrical practice in Power Stations. H.N.C. or equivalent qualifications desirable.

Salary AX/CX6, £600/£765.

SENIOR DRAUGHTSMAN (ELECTRICAL)

Vacancy No. 119/54

Salary, Schedule D, Grade 5, £640/£740.

ENGINEERING DRAUGHTSMAN (ELECTRICAL)

Salary, Schedule D, Grade 6, £510/£630.

Candidates should be suitably qualified and have had experience in the preparation of layouts and diagrams for the installation of power station auxiliaries, E.H.T. and L.T. switchgear, transformers and cables. Knowledge of protective gear systems advantageous.

Application forms obtainable from Secretary, South Wales Division, British Electricity Authority, Twyn-y-Fedwen Rd, Gabalfa, Cardiff, to be returned by 31 Dec., 1954. (P 217)

## SOUTH EASTERN ELECTRICITY BOARD

THIRD ASSISTANT DISTRICT ENGINEER

Lewes District

SALARY, £595/£640 per annum under N.J.B. Class D, Grade 9. Superannuable. Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems preferably up to 33 kV. Experience of DC/AC changeover an advantage.

Applications, naming 2 referees, to G. R. Lincoln, A.I.E.E., SEEBoard, 80/81, High St, Lewes, Sussex, by 29 Dec., 1954.

SHOWROOM SUPERVISOR (MALE)

Central Sussex District

Salary £605 by £20—£665 per annum under N.J.C. Grade 4. Superannuable. Applicants should possess a sound knowledge of electrical appliances and tariffs and be experienced in all branches of showroom work.

Applications, naming 2 referees, to Arthur Barnes, M.I.E.E., Central Sussex District Manager, SEEBoard, Electra Hse, Church Rd, Haywards Heath, by 29 Dec., 1954.

ASSISTANT DISTRICT ENGINEER

Ashford District

Salary £515 by £15—£560 per annum under N.J.B. Class D, Grade 11. Superannuable. Applicants should have technical training and practical experience in the construction, operation and maintenance of underground and overhead distribution systems. The position will entail standby duties.

Applications, naming 2 referees, to D. B. R. Roberts, A.I.E.E., Ashford Manager, SEEBoard, Victoria Rd, Ashford, Kent, by 29 Dec., 1954.

A. L. BURNELL,
Secretary.
(P 220)

## BRITISH ELECTRICITY AUTHORITY

**London Division**

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A or C. Salary includes London Allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. for posts (*a*) and Corporate Membership for posts (*b*) an advantage.

(*b*) SHIFT CHARGE ENGINEER
BANKSIDE GENERATING STATION

Vacancy No. 54/1034

Practical experience in operation of Power Station essential with experience of high pressure plant an advantage. Character and ability to deal with Staff problems essential. Salary—Class H, Grade 7=£882 per annum.

(*a*) ASSISTANT ENGINEER (SHIFT)
BARKING "A" AND "B" GENERATION STATION

Vacancy No. 54/1035

Experience in operation of E.H.T. switchgear, Station auxiliaries and control of large Turbo-Alternators an advantage. Duties of successful applicant will be those of Second Assistant to Station Shift Control Engineer in charge of Control Room. Salary—Class L, Grade 14=£708. 15s. per annum.

(*a*) JUNIOR ENGINEER
HACKNEY GENERATING STATION

Vacancy No. 54/1036

General duties within station. Salary—Class H, Grade 16=£500 per annum.

(*a*) ASSISTANT ENGINEERS (CONTROL)
HACKNEY GENERATING STATION

Vacancy No. 54/1037

Applicants will be expected to undertake Control Room duties in the "A" Station Control, with responsibility for synchronising, load control, and the necessary switching operations. Salary—Class H, Grade 12 =£666. 15s. per annum.

(*a*) STATION SHIFT CONTROL ENGINEER
WIMBLEDON GENERATING STATION

Vacancy No. 54/1038

Applicants should have a sound technical education and experience in the operation of Turbo-Generators and Control Room duties. Salary—Class E, Grade 10=£624. 15s. per annum.

(*b*) SECOND ASSISTANT ENGINEER
(EFFICIENCY AND TESTING)
CHIEF GENERATION ENGINEER'S (O) DEPARTMENT

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Vacancy No. 54/1039

Candidates should have a sound technical education and considerable experience in testing and investigational work on boilers, turbines and dust collecting plant. Successful candidate required for investigational work in London Division. Salary—Class AX/EX, Grade 2=£997. 10s./£1,245 per annum.

Applications, quoting vacancy number, may be made on form obtainable from Divisional Secretary, British Electricity Authority, London Division, P.O. Box 136, Generation House, Great Portland St, W.1, and be received within 14 days of this advertisement. (P 221)

## BRITISH ELECTRICITY AUTHORITY

**South Western Division**

GENERAL ASSISTANT ENGINEERS required in the Technical Department, Bristol and Plymouth.

Superannuation Scheme. Salary, N.J.B. Class AX/CX, Grade 6, £600/£765.

Applicants should possess qualifications leading to A.M.I.E.E., and have served with one of the leading electrical manufacturers. They should have an interest in protective gear design and generator and switchgear testing.

Applications on Form A.E.6/ACT, obtainable from Divisional Secretary, 26 Oakfield Rd, Bristol, 8, should be completed and returned by 1 Jan, 1955.

Previous applicants need not re-apply. (P 208)

## THE NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the appointment of THIRD ASSISTANT ENGINEER, Chief Engineer's Department, Operation and Maintenance Section, Communications Sub-Section, with location in Middlesbrough area.

Applicants should have qualifications entitling to Graduate Membership of I.E.E. and have a sound training and practical experience of magneto and automatic telephone systems, telephone repeaters, supervisory equipment and V.H.F. radio installations.

Salary—Schedule "C," Grade 4, £750/£950. N.J.B. Conditions of Service.

Applications stating age, qualifications, experience and positions held, should be forwarded to the Secretary, Carliol Hse, Newcastle-upon-Tyne, 1, within ten days of the appearance of this advertisement. (P 213)

ASSISTANT ELECTRICAL ENGINEER, aged 24 to 30 years, required for maintenance and installation work. Applicants must have a University degree in Electrical Engineering and have served an Apprenticeship with one of the leading Electrical Manufacturing Companies. A knowledge of electronics and instrumentation would be an advantage, but is not essential. Applications should be addressed to the Personnel Officer (Staff), Pilkington Bros. Ltd., St. Helens, Lancashire. (P 204)

A WELL-KNOWN Company manufacturing electrical rotating machinery, 1—100 h.p., has a vacancy for a SENIOR SALES ENGINEER based on their London office. The successful applicant must be trained electrical engineer with Ordinary National Certificate as a minimum qualification and with previous experience in the London or South Eastern counties area. The post carries a responsibility for the organisation and control of three sales engineers. A generous salary is offered together with non-contributory pension scheme.—Box No. 4077, Electrical Times. (P 137)

A WELL-KNOWN electrical Company has a vacancy for a SENIOR FUSEGEAR SALES ENGINEER. Applicants must be trained engineers with Ordinary National Certificate as a minimum qualification and have extensive commercial experience in this field. A generous salary is offered together with non-contributory pension scheme.—Box No. 4075, Electrical Times. (P 136)

BRITISH ELECTRICITY AUTHORITY are expanding their Generation Operation Branch and require the following staff for the undermentioned sections:

A. TECHNICAL STATISTICS SECTION. The work of the section involves the preparation of reports on the various aspects of the operation of power stations, the detailed investigation of statistical data, the design and organisation of records (with the co-operation of an existing Hollerith section) and the preparation of regular returns and reviews of power station operation.

(i) 2ND ASSISTANT ENGINEER

Salary N.J.B. Grade 2, £971/£1,325 p.a. inclusive.

To be responsible for the general supervision of a sub-section dealing with plant particulars, thermal efficiency and other technical statistics, generating plant availability and staffing arrangements at power stations. Candidates should have wide experience in the preparation of reports on technical subjects and in the supervision of a statistical section. Experience of generating station operation would be an advantage.

(ii) 3RD ASSISTANT ENGINEER

Salary N.J.B. Grade 3, £908/£1,125 p.a. inclusive.

To be responsible for matters concerning the availability of generating plant and related matters. The work involves the keeping of records, the compilation of regular summaries, reports and reviews and the preparation of reports as required.

B. OPERATIONAL RESEARCH SECTION. The work of this section involves application of Operational Research techniques to the engineering work of the Authority with particular reference to the examination and analysis of the performance of plant and the study of methods of improving the economy and efficiency of operation.

(iii) PRINCIPAL ASSISTANT ENGINEER

Salary, provisionally N.J.M. Scale 4, £1,650/£1,800 p.a. inclusive.

To take charge of the Operational Research Section

(iv) SENIOR ASSISTANT (MATHEMATICAL STATISTICIAN)

Salary N.J.C. Grade 6, £767/£845 p.a. inclusive.

Applicants for post (iii) should preferably be fully qualified engineers. Previous experience on Operational Research is desirable. A detailed knowledge of mathematics and statistical techniques would also be an advantage. For post (iv) a mathematical degree is necessary.

Applications in writing, stating age, qualifications, experience and present position and salary to D. Moffat, Director of Establishments, Winsley Street, London, W.1, by 22 Dec., 1954. Quote Ref.: ET/546. (P 179)

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BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough, Leics, has a vacancy for a RESEARCH ENGINEER to assist with projects connected with high voltage technology and the development of power transformers. A good Degree in Electrical Engineering or Physics is necessary with experience of transformer design, manufacture, associated techniques. Consideration will be given to candidates with suitable educational qualifications and experience of research in kindred fields who wish to develop further knowledge and experience in this important work. Existing facilities provide opportunities for original research. Please write with full details to the Chief Personnel Officer. (P 197)

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CONTRACTS ENGINEER required by Company in South Wales manufacturing electrical rotating machinery, 1—100 h.p. Applicants for preference should have served a recognised apprenticeship and possess O.N.C. as a minimum qualification. At least three years' experience in a commercial department is required. A generous salary is offered together with non-contributory pension scheme.—Box No. 4073, Electrical Times. (P 135)

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CLERK, aged 20-24 required by Electrical Contractors (Westminster) for Pricing Department. Electrical trade an advantage. Write, age, experience and salary required. —Box No. 4091, Electrical Times. (P 190)

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DESIGN ENGINEER required with experience in rectifiers, motor drives and magnetic controls. Good salary and pension. Apply with details of training, experience, etc., to Nevelin Electric Company Ltd., Purley Way, Croydon, Surrey. (P 235)

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DESIGN ENGINEER required for the development of outdoor type high voltage isolating switches and fuse gear for 11 kV and above. Applicants must have had good Drawing Office training and experience in the design of similar equipment. Write, giving full particulars of experience, age and salary required to—Box No. 4101, Electrical Times. (P 210)

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DRAUGHTSMAN required with experience of metal-clad medium voltage switchgear. Unfurnished house available. A.E.S.D. rate minimum. Reply stating age and experience to Ottermill Switchgear Ltd., Ottery St. Mary, Devon. (P 234)

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DRAUGHTSMEN required for Automatic Electric Control Gear; 5-day week, excellent working conditions; Canteen facilities; convenient transport; Incentive Bonus; Superannuation Scheme; salary according to qualifications, ability and experience. Apply Assistant Secretary, Watford Electric and Mfg. Co., Ltd., Watford, Herts. (P 29)

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ELECTRICAL MAINTENANCE ENGINEER required for service with the Sudan Light and Power Co., Ltd., in Khartoum, Sudan. Basic salary on appointment within the range £E.900/£E.1,380 per annum, according to age, qualifications and experience (£E.1=£1. 0s. 6d.).

Candidates should have had considerable experience on the maintenance of 6·6 kV and 11 kV switchgear and associated equipment for the remote control of generating sets including relay equipment and voltage regulators of the Brown Boveri type. A knowledge of motor rewinding would be an added qualification. Preference will be given to persons having a National Certificate in Electrical Engineering, and a good general education is essential.

Duties will include responsibility for the maintenance of all electrical equipment, both main and auxiliary, in the Power Station which has an installed capacity of approximately 12,500 kW of plant in the form of fourteen diesel engine generators supplying through a 6·6 kV truck-type switchboard. Work is in hand on an extension to the Power Station to house two 5 MW steam turbine sets and an 11 kV metalclad switchboard. The candidate chosen will be required to undertake the training of Sudanese Staff as part of his duties.

Appointment will be on contract by arrangement up to five years, including a period of 12 months' probation, with a bonus payable on completion of the contractual period. Free living accommodation with basic furniture or an allowance in lieu thereof will be provided. After satisfactory completion of the probationary period liberal leave on full salary with free passages. In addition to basic salary a cost of living allowance will be payable, and a kit allowance of £E.50 on appointment.

Applications stating age, education, qualifications, experience (with particulars of posts held), present appointment and salary with names of two referees should be submitted to the Secretary, The Power and Traction Finance Co., Ltd., Queen's Hse, Kingsway, London, W.C.2. (P 203)

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ELECTRICAL DRAUGHTSMAN required for the Electrical Division of the Engineering Department of Medium/Heavy Engineering Industry. Should have experience in preparation of drawings for electrical installation work and circuit diagrams. Applications to Personnel Manager, Rushton-Bucyrus Ltd., Excavator Works, Lincoln. (P 189)

---

ELECTRICAL INSTALLATION SUPERVISOR required for a one year contract by a large industrial organisation in Jamaica, B.W.I.

Applicants should have had at least five years' experience of industrial electrical installation work in a supervisory capacity. Possession of Ordinary National Certificate in Electrical Engineering desirable but not essential. Single man preferred, but consideration will be given to married men with good experience, age between 28 and 40.

Remuneration on a generous scale according to experience and qualifications. Passages paid from England to Jamaica and back.

Send applications giving full details to Reynolds Jamaica Mines Ltd., Lydford P.O., Jamaica, B.W.I. (P 162)

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ELECTRIC LAMP DEVELOPMENT ENGINEER. Crompton Parkinson Ltd. have a vacancy in their Lamp Development and Research Laboratories at Guiseley for Experienced Lamp or Radio Valve Technician, capable of carrying out specific investigations and development work on electric discharge lamps, etc. The position vacant, offers good salary rates, and good prospects of promotion. Preference given to graduate Physicist or Electrical Engineer. Superannuation Scheme. Write in confidence with full details to Reference LLD, Crompton Parkinson Ltd., Guiseley, Nr. Leeds. (P 188)

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ENGINEER, aged 25/35, with electrical or physicist degree required by Cable Company in London Area for development work on testing equipment for telecommunication cables. Permanent and pensionable position at salary commensurate with experience and qualifications. Apply giving full particulars to—Box No. 4059, Electrical Times. (P 64)

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ESTABLISHED firm of electrical contractors in the Manchester area require the services of an ESTIMATING ENGINEER for industrial and commercial electrical installation contracts. Only those candidates who have had some practical and drawing board experience and who are in a position to prepare competitive estimates and schemes need apply. Reply in confidence, giving some indication of salary, age and previous experience.—Box No. 4045, Electrical Times. (P 35)

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ELECTRICAL DESIGNER required. Must have practical experience in the design of A.C. and D.C. motors, 1-200 B.H.P. Reply in confidence, stating age, experience, and salary expected. Hugh J. Scott and Co. (Belfast) Ltd., Volt Works, Ravenhill Rd, Belfast. (P 229)

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ELECTRICAL ENGINEER required by Electrical Contracting Company for service in British West Africa. Must have experience on preparation of specifications and estimates and supervision of contract work. Remuneration, including allowances, will depend on age and experience, but will start at not less than £1,000 per annum. Free furnished quarters, free passages and medical attention. Pension fund. Apply giving experience, qualifications and age to —Box No. 4097, Electrical Times. (P 205)

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ELECTRICAL WHOLESALER, experienced COUNTER HAND required, also ASSISTANT. Apply Newey and Eyre Ltd., 243 Horn Lane, Acton, W.3. (P 107)

---

EXPERIMENTAL OFFICER required by The Research Laboratories of British Insulated Callender's Cables Limited at Shepherds Bush for the design and construction of experimental apparatus. Applicant should have good knowledge and experience of light mechanical and electrical apparatus with some knowledge of electronics. 5 day week. Pension Fund. Apply in writing, stating age, qualifications, experience, salary required and quoting reference L/65/54 to Staff Officer, British Insulated Callender's Cables Limited, 21 Bloomsbury St, London, W.C.1. (P 237)

# Insulation Engineers Required

Must have knowledge of all modern organic and inorganic insulating materials used in the electrical engineering industry. Previous experience in the application of such material to small rotating machines is essential. Practical experience in the winding of rotors and stators is desirable. This interesting work brings the successful applicant into contact with all phases of aircraft electrical engineering.

Write as fully as possible, stating your age and experience to the Personnel Dept., Rotax Limited, Chandos Road, Willesden Junction, London, N.W.10.

(P 46p)


F.H.P. MOTOR DEVELOPMENT. ENGLISH ELECTRIC, Bradford, wish to appoint an ENGINEER to take charge of the mechanical development of electric motors and associated equipment for economic production. This is a new and interesting appointment for a fully qualified and experienced engineer. Please apply, giving full details of experience and qualifications, etc., to Ref. 1161B, Dept. C.P.S., 336/7 Strand, W.C.2. (P 164)

FULL-TIME REPRESENTATIVE required by well-established manufacturers of high grade switches to cover the Northern Counties of England. Pleasant personality and contacts with leading electrical manufacturers and Area Boards. Knowledge of switching applications particularly packet, rotary and toggle switches an advantage. Reply giving full details including experience, remuneration expected and whether a car owner to—Box No. 4093, Electrical Times. (P 191)

INTELLIGENT YOUTH required for London Depot. Duties include driving 10 cwt Van, light deliveries, keeping records, generally assisting London Manager. Wages £7 plus Commission. Good prospects for right person. Apply either by letter or person, mornings only to EGA Electric Ltd., 127 Pancras Rd, N.W.1. (P 195)

LARGE D.C. MACHINE DESIGN. ENGLISH ELECTRIC, Bradford, has a vacancy for a SENIOR ENGINEER with experience in D.C. machine design of 1,000 kW range. These motors and generators have interesting and special application in a wide industrial field. This is a senior appointment carrying an attractive salary. Please apply in strict confidence, to Ref. 758H, Dept. C.P.S., 336/7 Strand, W.C.2. (P 165)

LIGHTING ENGINEER. I.E.S. member required for London Office, age 25-35 years. Box No. 8210, c/o Charles Barker and Sons Ltd., 31 Budge Row, London, E.C.4. (P 211)

INDUSTRIAL MATHEMATICIAN, English Electric, Bradford, wish to appoint a Mechanical Engineer/Mathematician for interesting work in the Industrial Motor Development Department. His main duties will be to take over and organise routine stress calculations as applied to all types of industrial motors and larger machines, and to analyse vibrations and similar problems.

The applicant should be a competent mathematician and should preferably have an engineering degree and a certain amount of practical engineering experience. This is an interesting appointment with a good salary for right engineer. Please apply in strict confidence to Ref. 1369, Dept. C.P.S., 336/7 Strand, W.C.2, stating full personal qualifications and experience. (P 198)

REPRESENTATIVE required for the South West Area by old-established Manufacturers of Open Type Switch and Fusegear, Plugs and Sockets, Lighting Fittings and Accessories. A good connection essential with Electricity Boards, Electrical Wholesalers, Engineering Establishments and Industrial undertakings. Car essential.

Applicants with two other non-competitive agencies would also be considered. Apply in writing only giving full particulars of experience, age and salary required to Secretary, William McGeoch and Co., Ltd., Manufacturing Electrical Engineers, 46 Coventry Rd, Birmingham 10. (P 207)

REPRESENTATIVES with established connections amongst Electrical Retailers required. Commission Basis.—Box No. 4105, Electrical Times. (P 231)

REPRESENTATIVE required by progressive Mfg. Co. of Elec. Engineers, E. London, to handle domestic lines. Connections with wholesalers an advantage but not essential. Remuneration will consist of basic salary plus commission based on results obtained. Applicants should be prepared to travel U.K. Write giving full details of age, experience and present earnings, to—Box No. 4103, Electrical Times. (P 230)

REPRESENTATIVE required for London and South Coast Area, based at our London Office, with good contacts amongst Manufacturing Electrical Engineers, Electricity Boards, Wholesalers and Engineering Establishments. Preference will be given to applicants having experience of Ministry and Government Departments requirements. Progressive post (superannuated) available for keen and energetic man not older than 45, car an advantage. Salary, Bonus and Expenses paid. Apply in writing only, giving full particulars of experience, age and salary required to the Secretary, William McGeoch and Co., Ltd., Manufacturing Electrical Engineers, 46 Coventry Rd, Birmingham 10. (P 90)

SWITCHGEAR DRAUGHTSMEN required, with knowledge of H.V. Outdoor Switchgear and/or 11 kV Oil-Immersed Metal-clad gear. Interview expenses paid. Help given to obtain accommodation if necessary. Apply in writing, giving details of qualifications, experience and salary, to Switchgear and Equipment Ltd., Banbury, Oxon. (P 129)

SALES ENGINEER required for London and Southern Counties by progressive company manufacturing Switchgear and Distribution equipment. Applicants should preferably have had experience in the manufacture, installation and operation of distribution equipment for MV and HV systems. Write, giving full particulars of experience, age and salary required to—Box No. 4099, Electrical Times. (P 209)

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Apply giving full details including age, technical qualifications, whether married or single, and salary required to the Expanded Metal Co., Ltd., Electrical Department, Stranton Works, West Hartlepool. (P 181)

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Dear Sir,

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(P 236p)

TRANSFORMER TEST ENGINEER required having experience in routine testing of Distribution, Medium and Large Power Transformers. Preference will be given to applicants holding H.N.C. Electrical Engineering. This is a permanent position with good prospects. Apply stating age, experience and salary required to Denis Ferranti Co., Ltd., Royton, Oldham, Lancs. (P 128)

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required for work on Power Cables. Experience in the field of Plastics would be a distinct advantage. Salary fully commensurate with qualifications and experience. Applications giving full particulars of qualifications and experience to:

**Employment Manager,**
**Messrs Johnson and Phillips Ltd.,**
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(P 183p)

THE ENGLISH ELECTRIC CO., LTD., Stafford, has interesting vacancies for ENGINEERS to assist with contracts for comprehensive hydro - electric schemes. Applications are invited from those having experience of this type of work and also from young engineering graduates or H.N.C. holders who have a background of practical engineering experience, preferably with a commercial bias. Please apply to Dept. C.P.S., 336/7 Strand, W.C.2, quoting ref. 756D. (P 108)

## CHIEF BUYER

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**Box 2J, M3363,**
**A.K. Advg., 212a Shaftesbury Ave,**
**London, W.C.2.**

(P 121p)

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Applications giving details of experience, qualifications and salary required, quoting D.O.29, should be addressed to the Personnel Manager, The Bristol Aeroplane Co., Ltd., Aircraft Division, Filton Hse, Bristol.

(P 182p)

WELL-KNOWN Electrical Manufacturing Company has a vacancy for a SALES ENGINEER for electrical rotating machinery in Sheffield. Successful applicant must be a trained Electrical Engineer with O.N.C. as a minimum qualification and with previous sales experience in the area covered. He will work from the Company's existing Branch Office. Remuneration by salary and expenses. Non-contributory pension scheme. Apply—Box No. 4065, Electrical Times. (P 111)

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(P 212p)

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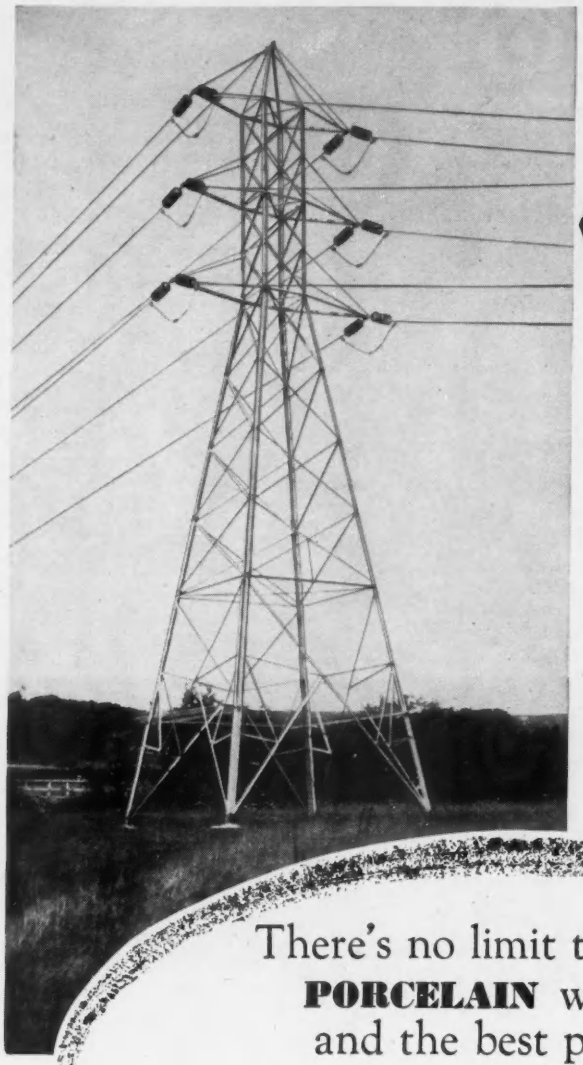

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100 amps. — 2000 amps.

— in —

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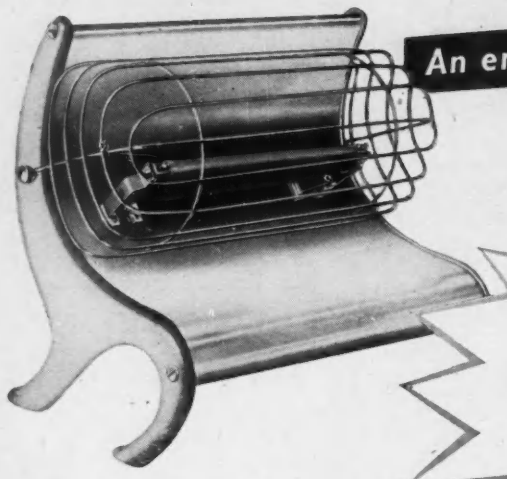

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E45

# "It's all works and no space!"

*said the Works Manager*

*He didn't look good at all. All the marks of a long spell of strain. "For months I've been doing the impossible", he bawled, as we threaded our way through the factory. "And because I did it last time they think I can do it again. Not a square inch of floor space, and* now *I'm told to find room for a test bench . . ." We stopped him before he exploded. Gently we told him his worries were at an end. We were from Yale. We'd been called in by the management to plan a new scheme for materials handling.*

*"Materials handling? . . . that's what I told them six months ago! Clear at least three aisles and we could stack to the end bay northlight . . . Well, well.*

*Here, let me show you the annexe . . ."*

*He moved like a different man. He had ideas. We had ideas. Together we plotted a scheme that gave him just what he wanted. And, not surprisingly, we pleased the management too — when they saw the turn their costs would take.*

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### Yale's versatile

# "WORKSAVER"

### is specially suitable for smaller plants

AMONG the wide range of Yale handling equipment the "Worksaver" series of electric trucks is of special interest to factories where restricted space or low-load floors have previously made mechanical handling impractical. Its small size, light weight and extreme ruggedness give big-truck advantages with small-truck economy and convenience.

It will lift, move and stack raw materials or finished products. It saves time, space and manpower. You can ride it or walk it. And it will start cutting costs from the minute you put it to work.

The "Worksaver" is available in five basic types : pallet, low-lift platform, high-lift platform, fork-lift and tractor.

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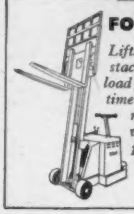
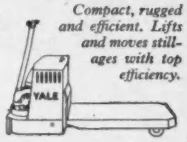


*Lifts, moves and stacks over low-load floors: saves time, space and manpower wherever it's put to work.*

**PLATFORM**



*Compact, rugged and efficient. Lifts and moves stillages with top efficiency.*

**TRACTOR**

*A powerful and manœuvrable tractor unit to pull trailers or trailer trains with up to 700 lbs. drawbar pull.*

**PALLET** *Built to stand up to rugged jobs. Lifts and moves maximum load pallets with ease and accuracy.*

### YOU GET ALL THESE ADVANTAGES WITH THE "WORKSAVER"

- *Manœuvrable in small spaces and narrow aisles.*
- *Light weight with great strength and power permit heavy duty work on low-load floors.*
- *Dead man control cuts power and applies brakes automatically in emergency.*
- *Simple fingertip controls—unskilled staff can move, lift and stack with speed and safety.*
- *Low initial cost, low running cost, economical maintenance, long life.*

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MADE IN ENGLAND BY

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**40/60 WATT**
**FLAMEPROOF HANDLAMP**

**FLP 3213 Groups II & III**

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**HEYES & COMPANY LIMITED**
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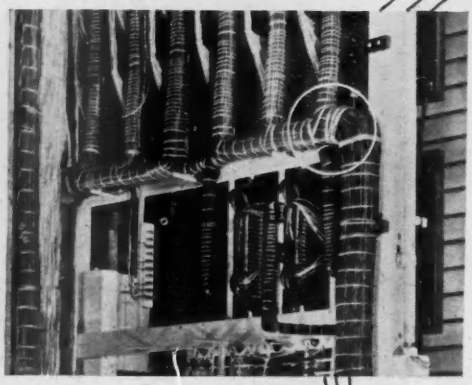

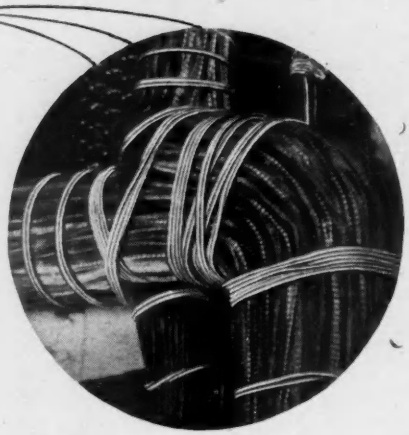

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has more than proved equal to the job.

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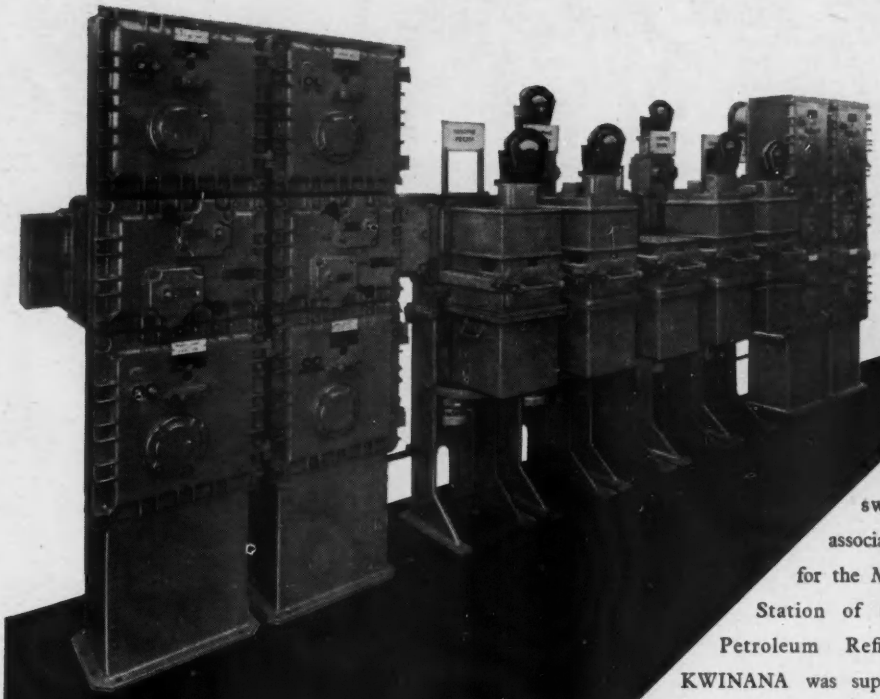
**FINLAYSON, BOUSFIELD & CO., LTD., JOHNSTONE, SCOTLAND**



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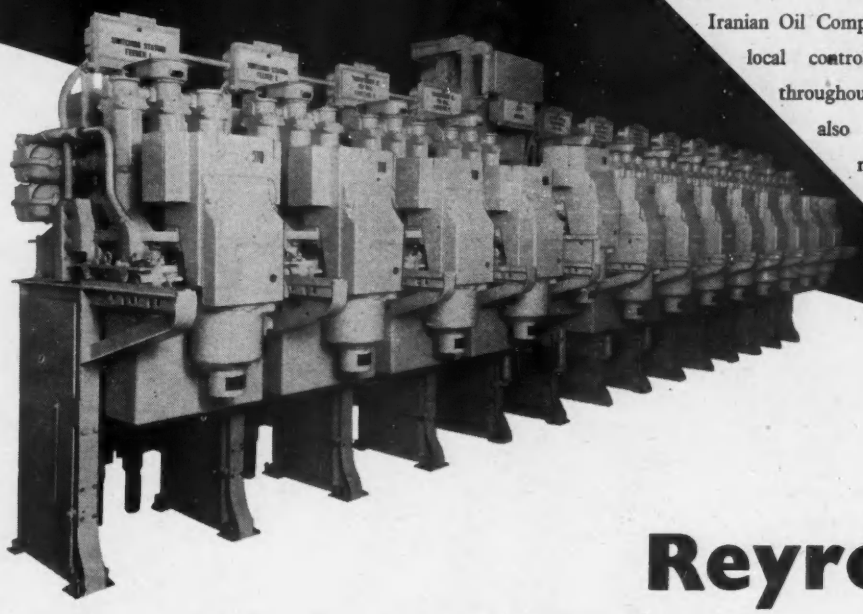
All of the high - voltage switchgear with its associated control-board for the Main Transforming Station of the Australasian Petroleum Refineries Ltd at KWINANA was supplied by Reyrolle, who also provided the distribution switchgear for the Area and Satellite Sub-stations.

The flameproof equipment, built to the special requirements of the Anglo-Iranian Oil Company Ltd for the local control of processes throughout the plant, is also of REYROLLE manufacture.



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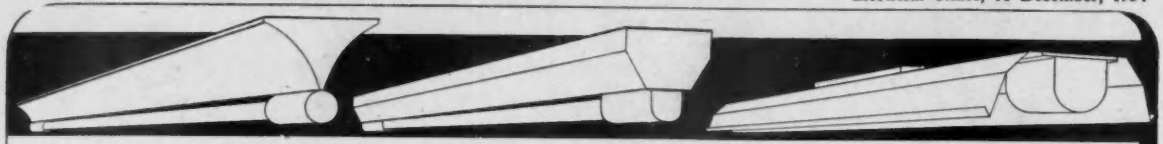

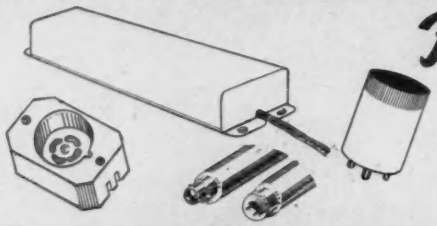

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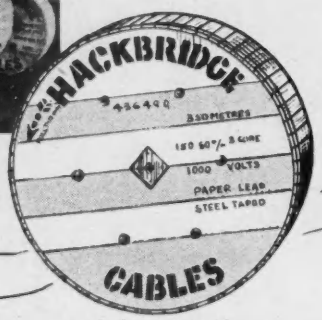


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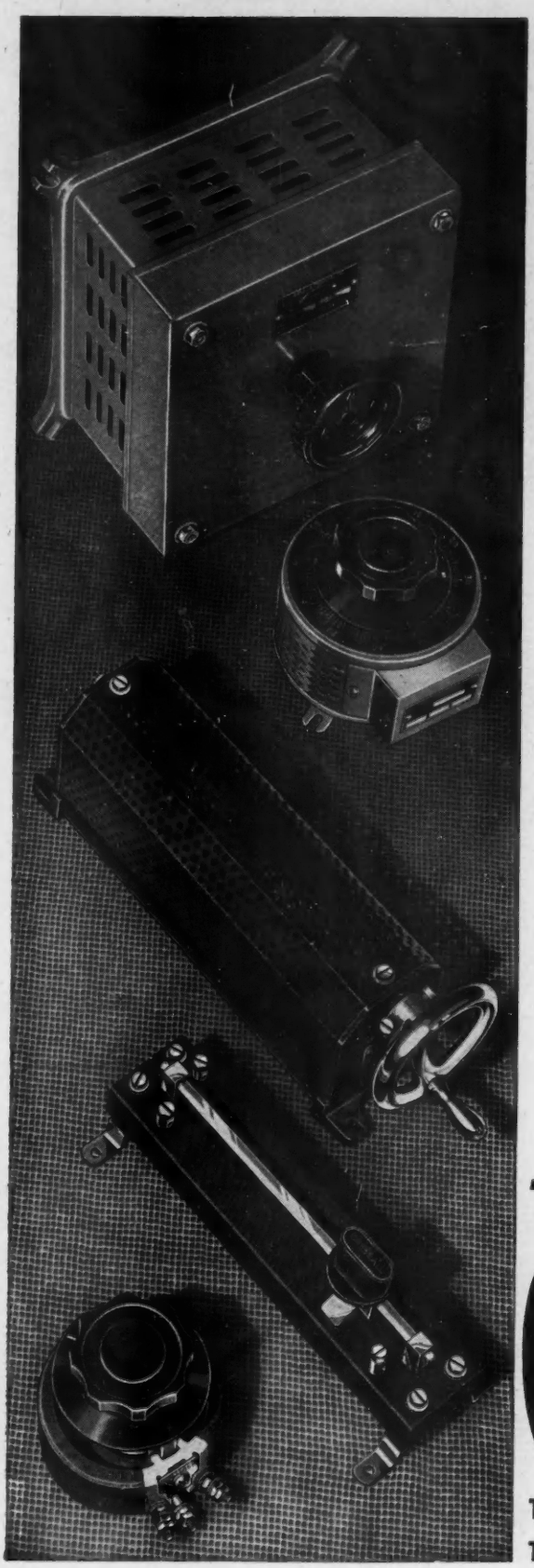

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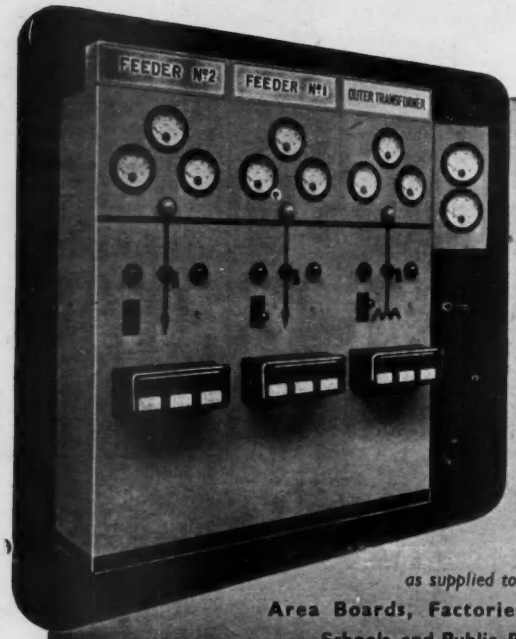


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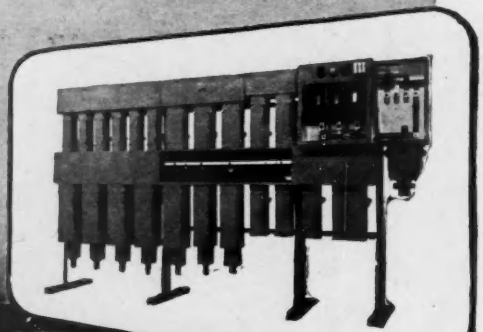

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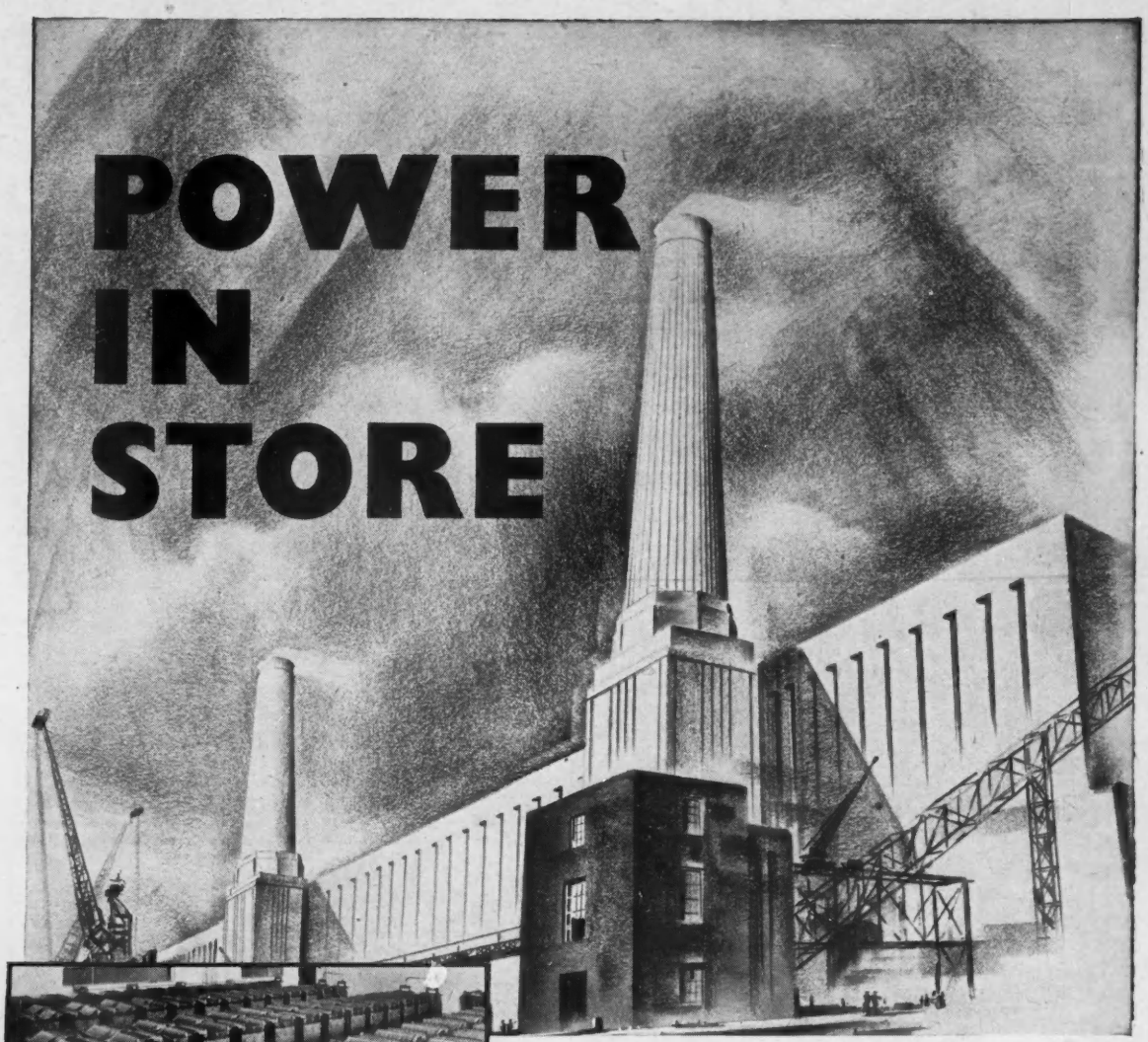

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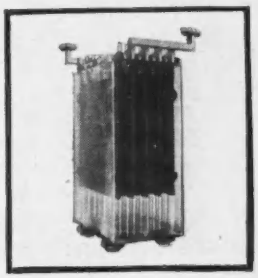

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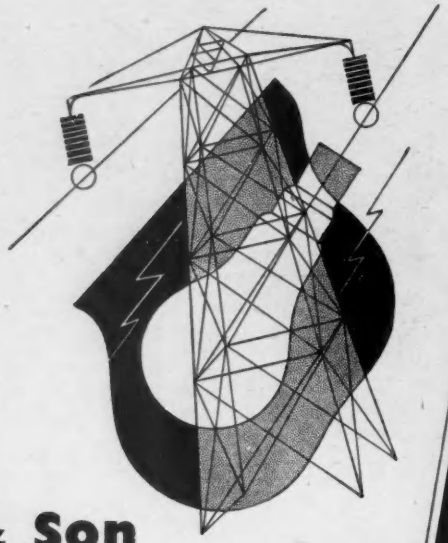

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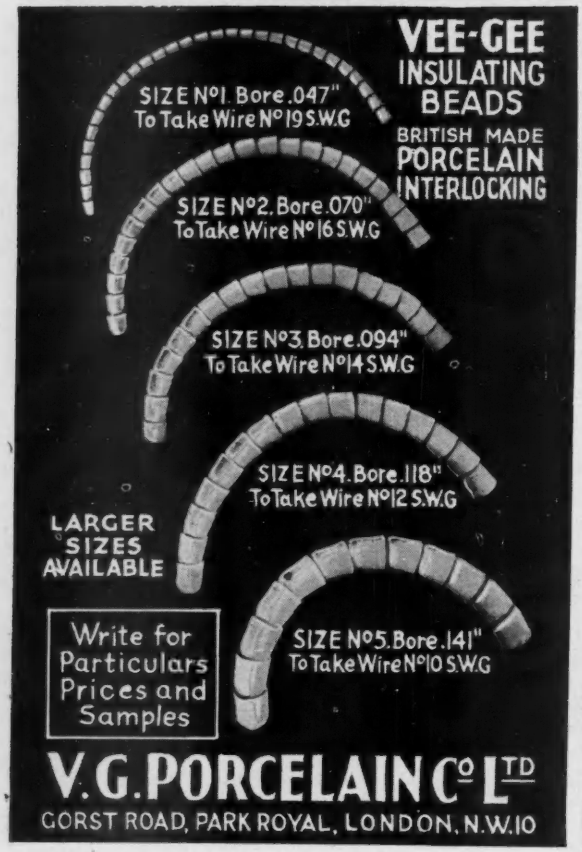


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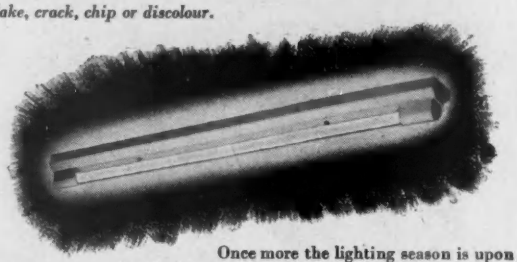

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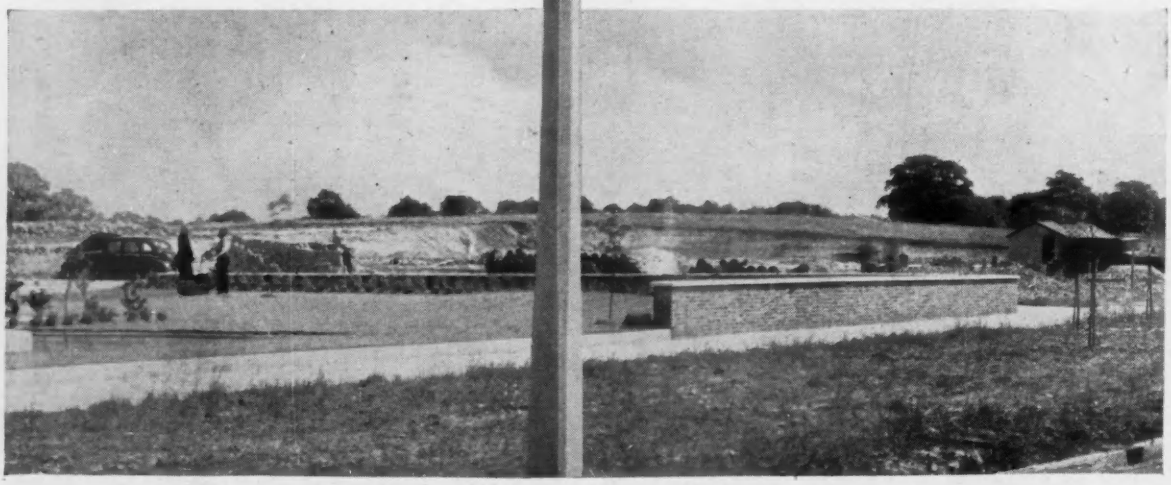

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## Another BTH Achievement

# Mazda

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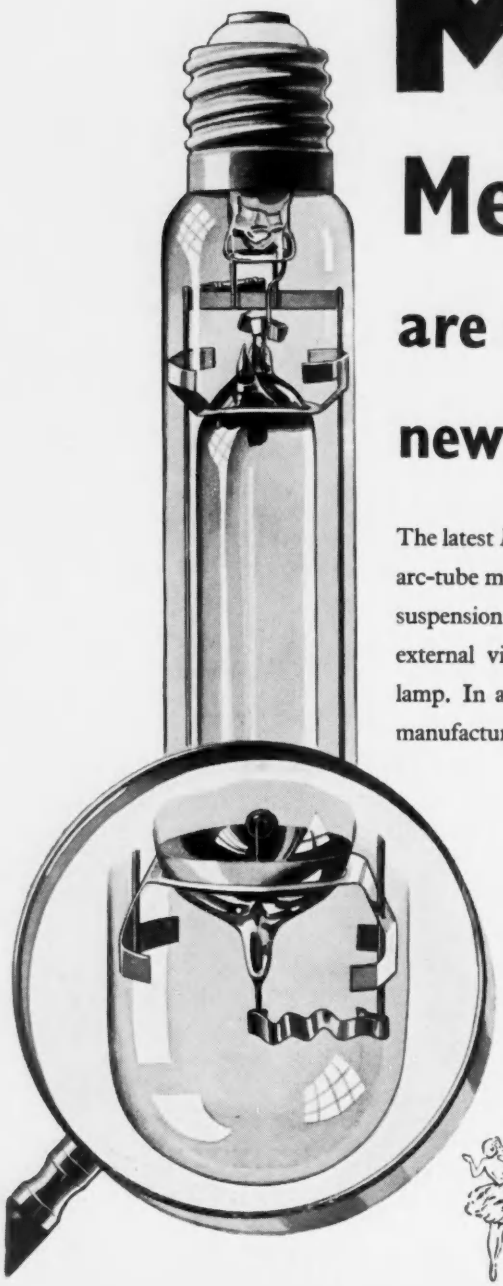
### are now fitted with the new BTH Arc-Tube mount



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